

**Research to Evaluate the Fairness, Use,
and Predictive Validity of the MCAT® Exam
Introduced in 2015 (published in the March
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Foreword

Today's physicians must be capable of applying scientific knowledge and reasoning skills to solve complex problems in clinical care and research. Medical knowledge is exploding, health care delivery is changing, and physicians are caring for an increasingly diverse and aging patient population. Now more than ever, medical educators must ensure future physicians are prepared to care for patients from all backgrounds and communities, including those that have fewer resources and less access to health care services. The redesigned MCAT® exam was introduced in 2015 to reflect this reality and better assess the concepts and reasoning skills students need to be ready for the medical school curriculum.

The AAMC formed the MCAT Validity Committee (MVC) to evaluate the fairness, use, and predictive validity of the new exam. We are the co-chairs of this committee, whose members are educators, admissions officers, researchers, and prehealth advisors from medical schools and undergraduate institutions in the United States and Canada. Our research includes a 10-year study following several cohorts of students through medical school to examine the predictive validity of MCAT scores in relation to local and national performance outcomes. The research also examines national trends in the test preparation and performance of individuals who take the MCAT exam, and how admissions officers and their committees use MCAT scores in medical student selection. This publication includes the first collection of articles from the MVC's research, originally published in the March 2020 issue of *Academic Medicine*.

The first article by **Busche** et al.¹ describes how well MCAT scores predicted students' academic success in the first year of medical school both alone and when used with undergraduate grade point averages (GPAs). They found that MCAT scores do a good job of predicting students' performance in their first-year courses and their on-time progression to the second year of medical school and that students with a wide range of scores perform well. A second article by **Girotti** et al.² reports on how examinees from different backgrounds prepared for and performed on the MCAT exam. Their analyses include a close examination of the preparation and performance trends of students who attended undergraduate institutions with different levels of resources and by their socioeconomic status. A Last Page by **Swan Sein** et al.³ follows, offering students guidance on how to strategically prepare for the MCAT exam. A Perspective by **Terregino** and colleagues⁴ draws on the findings from **Busche** et al. that students with MCAT scores across the score range perform well in medical school. Their research shows that a more flexible approach to using MCAT scores can help build more diverse classes. The Perspective by **Lucey and Saguil**⁵ reviews the impact of structural racism and

institutional roadblocks on the success of disadvantaged students and students from minorities underrepresented in medicine. It stresses the importance of using a holistic lens in conducting medical school admissions and also innovative approaches to addressing inequities. Finally, the commentary by **Schwartzstein**⁶ emphasizes the need to admit students with both the scientific knowledge and interpersonal competencies necessary to excel in medical study and practice. He, too, recognizes the impact of structural inequalities in limiting educational opportunity and suggests ways medical schools can partner with premedical educators to help students from disadvantaged backgrounds obtain the necessary preparation to succeed in medical school and beyond.

Predictive Validity of MCAT Scores

The research presented in the first article by **Busche** and his coauthors¹ describes the strong relationship between MCAT scores and students' future performance in medical school. They found medium to large associations between MCAT scores and students' grades in their first-year courses. They also examined the predictive value of using MCAT scores alone and together with undergraduate GPAs and showed that using both metrics provides better prediction of performance than using either one alone.

Importantly, their research shows that students from different backgrounds who enter medical school with the same MCAT score have similar academic outcomes. The authors found that MCAT scores predict performance comparably for students from racial and ethnic minority and majority groups, for those from lower and higher socioeconomic backgrounds, and for females and males.

Their research also found that students with a wide range of MCAT scores reach an important milestone in completing the first year of medical school. Overall, 97% of students progressed on time to their second year.

Additional research findings reported since this article's publication show that MCAT scores predict students' performance in their second-year courses, their performance on the United States Medical Licensing Examination Step 1 exam, and the time it takes them to progress to Year 3.⁷ The prediction continues to be stronger when students' MCAT scores are considered together with their undergraduate GPAs. Additionally, MCAT scores provide comparable prediction of students' Year 2 and Step 1 performance and in their progression to clerkship rotations. That MCAT scores provide the same predictive value for applicants from different backgrounds as they make their way through medical school is an essential source of evidence about the fairness of using MCAT scores in medical student selection.

Group Differences in MCAT Preparation and Performance

Studying group differences in MCAT scores is central to the MVC's research given historical findings that examinees from lower socioeconomic backgrounds and races and ethnicities underrepresented in medicine score lower, on average, than their peers from majority groups. Research on academic achievement and educational opportunities reveals that differences in students' home, school, and community circumstances translate into gaps in students' achievement in K-12 education and college, on standardized tests, and even in the undergraduate GPAs of medical school applicants.⁸

The designers of the new MCAT exam recognized that it must assess a wider range of concepts and scientific reasoning skills than the old one did, which in turn might increase group differences in test scores. Research on premedical students' opportunities to learn these foundational concepts, including targeted investigations at minority-serving and underresourced undergraduate institutions, informed the new test blueprints. Additionally, creating easily accessible free and low-cost preparation materials, providing financial assistance for students in need, and targeting outreach to students from disadvantaged backgrounds aimed to deliver the resources and information students needed to prepare for the exam.

Girotti and his coauthors² studied the performance of examinees who took the new exam, comparing current trends to the past. Their data show that, even though the MCAT exam now tests more concepts, differences between the average MCAT scores of examinees from minority and majority groups are no larger or smaller than they were on the previous exam. Although examinees from minority groups score lower, on average, than those from majority groups, there are examinees from every group who obtain scores in the lower, middle, and higher ranges of the MCAT score scale.

Prior research on the old exam⁸ and the findings presented in **Busche** et al.¹ provide evidence that these average score differences do not stem from technical deficiencies in the exam. That is, evidence that students from different backgrounds admitted with the same MCAT score showed similar levels of success in medical school indicates that these scores do not show predictive bias.

Despite the widespread dissemination of free and low-cost preparation resources, **Girotti** and his coauthors found that examinees from lower socioeconomic backgrounds and who attended less-resourced colleges and universities reported lower use of many free and low-cost MCAT preparation resources than their more advantaged peers. The MVC has been exploring students' preparation strategies and barriers to understand

these differences. The Last Page by **Swan Sein** and her coauthors³ offers guidance, learning strategies, and information on free resources to help students strategically prepare for the MCAT exam. Providing all examinees, especially those from disadvantaged backgrounds, with the opportunity and resources to prepare for the MCAT exam is an essential component of the MVC's research agenda.

MCAT Scores and Medical School Admissions

The MVC's research underscores the important relationship between students' economic and educational backgrounds and their academic achievement. **Terregino** and her coauthors⁴ explored the diversity and success of applicants scoring in the middle of the MCAT score scale (495-504) compared to applicants in the upper range (505-528). They found that medical schools enrolling higher percentages of students with scores in the middle range were able to create more diverse student bodies than those schools that admitted few to no students in this range.

They also show that students with a wide range of MCAT scores can succeed in medical school. A key finding is that 95% of students scoring in the middle of the MCAT score scale progressed to Year 2 on time – the first hurdle in completing medical school with unimpeded progress. That students with mid-range scores progress at nearly the same rate as those with upper-range scores reinforces that medical schools support the students they admit by leveraging the curricular, academic support, and learning environments that have been designed to help them meet their educational goals and students' needs.

The authors stress that using MCAT scores in holistic review provides admissions officers with important context for interpreting applicants' academic backgrounds and selecting students who will help them meet their schools' missions and goals. In **Lucey and Saguil's**⁵ Perspective on medical school admissions and societal inequality, we pull together evidence to present ways that, historically and even today, governmental programs, education, housing, and other facets of society provide unequal opportunities to citizens of different racial and ethnic groups, contributing to disparities in wealth, health, and academic achievement. For students from racial and ethnic minority groups, years of structural and interpersonal racism and bias have deepened the effects of socioeconomic inequality that presents barriers to academic achievement. Designing admissions policies and procedures holistically to consider applicants' academic achievements in this context is an essential lever for mitigating the effects of this inequality.

Terregino and her coauthors encourage us to study the curricula and support programs of medical schools that enroll larger percentages of students with MCAT scores

in the middle of the scale to help all schools enhance their ability to increase the diversity of their classes with capable, academically ready students. In **Lucey and Saguil's** Perspective, we also urge study of the pioneering efforts led by medical schools to increase the diversity of their student bodies and address the deleterious effects of structural inequalities. We highlight successful medical school pipeline programs around the country and innovative curricula on the social and behavioral determinants of health being taught throughout the medical education continuum to counteract inequities.

Finally, an invited commentary by **Schwartzstein**⁶, a member of the committee that developed the new MCAT exam, reminds us of the importance of valuing academic data appropriately as a signal of applicants' critical thinking skills and foundational science knowledge needed to master the scientific principles taught in medical school. **Schwartzstein** argues that academic readiness, while necessary, is insufficient for students to succeed in medical school and as physicians — students must come with the personal qualities that are the bedrock of good physicians.

Finding ways to address the effects of unequal opportunity earlier in students' academic careers is key to expanding the pipeline of applicants from diverse backgrounds and will elevate our ability to identify the applicants with the myriad experiences, backgrounds, academic competencies, and humanistic qualities needed of our medical students and future physicians. **Schwartzstein** expands on points made by **Lucey and Saguil** on the importance of investing in initiatives that will mitigate the

effects of structural inequalities so that medical schools can better prepare students from disadvantaged and underrepresented backgrounds to become successful physicians. Among the efforts, **Schwartzstein** calls for medical schools to form more partnerships with undergraduate institutions serving disadvantaged students and utilize online course technology in the classroom to supplement their learning.

MCAT Validity Committee

We thank our colleagues for their commitment to studying the validity of the new MCAT exam and its intersection with important issues in medical school admissions. There is more to learn, and the MVC's future research will include studying the value of MCAT scores and undergraduate GPAs in predicting students' clerkship performance, performance on the Step 2 exams (CK and CS), and graduation within four or five years. The committee's work is essential to developing the tools and resources the admissions community needs to use MCAT scores in the full context of applicants' academic achievements, attributes, and lived experiences. The MVC welcomes the opportunity to contribute research that will advance our medical schools' shared goal of developing capable, compassionate physicians to care for our increasingly diverse nation.

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The Validity of Scores From the New MCAT Exam in Predicting Student Performance: Results From a Multisite Study

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Abstract

Purpose

The new Medical College Admission Test (MCAT) was introduced in April 2015. This report presents findings from the first study of the validity of scores from the new MCAT exam in predicting student performance in the first year of medical school (M1).

Method

The authors analyzed data from the national population of 2016 matriculants with scores from the new MCAT exam (N = 7,970) and the sample of 2016 matriculants (N = 955) from 16 medical schools who volunteered to participate in the validity research. They examined correlations of students' MCAT total

scores and total undergraduate grade point averages (UGPAs), alone and together, with their summative performance in M1, and the success rate of students with different MCAT scores in their on-time progression to the second year of medical school (M2). They assessed whether MCAT scores provided comparable prediction of performance in M1 by students' race/ethnicity, socioeconomic background, and gender.

Results

Correlations of MCAT scores with summative performance in M1 ranged from medium to large. Although MCAT scores and UGPAs provided

similar prediction of performance in M1, using both metrics provided better prediction than either alone. Additionally, students with a wide range of MCAT scores progressed to M2 on time. Finally, MCAT scores provided comparable prediction of performance in M1 for students from different sociodemographic backgrounds.

Conclusions

This study provides early evidence that scores from the new MCAT exam predict student performance in M1. Future research will examine the validity of MCAT scores in predicting performance in later years.

Editor's Note: An Invited Commentary by R.M. Schwartzstein appears on pages 333–335.

The Medical College Admission Test (MCAT) is a tool for assessing applicants' academic readiness for learning in medical school. It is a standardized examination that measures the foundational knowledge of scientific concepts and reasoning skills needed by entering medical students. Medical school admissions committees use academic metrics, such as MCAT scores and undergraduate grade point averages (UGPAs), with other information about applicants' academic preparation and experiences as well as insights

gathered during interviews, when making admissions decisions. Because the meaning of UGPAs differs for applicants from different undergraduate institutions and with different majors and coursework,¹ MCAT scores provide an important common measure of academic readiness.

In April 2015, the Association of American Medical Colleges (AAMC) introduced a new version of the MCAT exam. The exam was redesigned to reflect changes in medical education, medical science, and health care delivery as well as changes in society and the increasingly diverse and aging patient population in the United States and Canada, which have occurred since the last revision of the MCAT exam in 1991.^{2,3} The new exam still tests foundational concepts in biology, chemistry, and physics, along with verbal reasoning skills; now, it also includes concepts from first-semester biochemistry and introductory psychology and sociology. The new exam also requires applicants to demonstrate more scientific reasoning skills than the old exam did.

In 2014, the AAMC formed the MCAT Validity Committee (MVC) to evaluate the validity of scores from the new MCAT exam. The committee includes representatives from 16 U.S. and 2 Canadian medical schools and 2 prehealth advisors serving in current or previous leadership roles with the National Association of Advisors for the Health Professions. The MVC is tasked with evaluating evidence about the fairness, impact, use, and predictive validity of scores from the new MCAT exam, as professional testing standards require.⁴ This research is the foundation for evaluating the soundness of using MCAT scores in admissions decisions.

The predictive validity research conducted by the MVC examines the value of scores from the new MCAT exam in predicting medical student performance on a variety of outcomes throughout medical school, including student performance in individual preclerkship and clerkship courses, passing the United States Medical Licensing Examination (USMLE) Step exams, and progression through and graduation from medical school. This research also examines whether

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MCAT scores provide comparable prediction of performance in medical school for students from different sociodemographic backgrounds.

Research on the old MCAT exam (1991 to January 2015) addressed these same questions. Findings from previous research showed that scores from the old MCAT exam predicted student performance throughout medical school.⁵⁻¹¹ Prior research also found that scores from the old exam provided similar prediction of performance on the USMLE Step 1 exam and medical school graduation for students from different racial/ethnic backgrounds.^{8,12}

In this research report, we present the results from the MVC's first multisite study on the predictive validity of scores from the new MCAT exam. We examined the extent to which total scores predict student performance in the first year of medical school (M1). Specifically, we addressed the following 3 research questions:

1. Do the total scores from the new MCAT exam predict students' summative performance across first-year courses and on-time progression to year 2 (M2)?
2. Do the total scores from the new MCAT exam add value beyond UGPAs in predicting students' summative performance across first-year courses?
3. Do the total scores from the new MCAT exam provide comparable prediction of summative performance across first-year courses and on-time progression to year 2 for students from different sociodemographic backgrounds?

Method

Participants

We used data from 2 groups of 2016 medical school matriculants in our analyses: (1) the national population of 2016 matriculants with scores from the new MCAT exam and (2) the sample of 2016 matriculants with scores from the new exam who attended one of the medical schools conducting MCAT validity research (validity schools) and who volunteered to participate in the research on their institution-specific student outcomes.

We refer to the first group as the national population because it included all 2016 matriculants to every U.S. MD-granting institution who had scores from the new MCAT exam (N = 7,970). These students were a subset of the more than 21,000 students who matriculated at the 145 accredited U.S. MD-granting institutions in 2016.

We refer to the second group as the validity sample. It includes the students who were enrolled in one of the 16 medical schools participating in the MCAT validity research who volunteered to participate in this study. These schools were selected from 65 medical schools that volunteered to participate in the MCAT validity research. They represented a wide range of institutional missions, geographic regions, public/private status, applicant pool sizes and characteristics, curricula, instruction, and grading practices.

About 80% (N = 955) of the students with scores from the new MCAT exam who matriculated in 2016 at the validity schools volunteered for the study. Among these 955 students, 83% (N = 791) came from U.S. medical schools and were also a subset of the national population of 2016 matriculants with scores from the new MCAT exam. The remaining students (N = 164) came from 2 Canadian schools. The validity sample was representative of the total population of 2016 matriculants at the validity schools (N = 2,541) based on demographic characteristics and undergraduate academic performance.

Data from these 2 groups complemented each other. The national population included more students and represented more schools, and it allowed for the study of the first milestone in medical school—sufficient mastery of the curriculum to progress on time to the next year. The validity sample was smaller, but it allowed for our examination of institution-specific outcomes.

We drew our data from deidentified research tables in the AAMC's Data Warehouse and from outcome data provided by the validity schools. This study was approved by the institutional review board of the American Institutes for Research.

Criterion outcomes

We used 2 types of criterion outcomes in this study.

Summative performance in M1. The validity schools identified M1 courses to include in this evaluation. To be included, courses had to have at least one medical student performance outcome that met the following criteria: measured individual (not team) performance, had adequate variation in student performance, represented students' first attempts on these outcomes, and were continuous, ranging from 0 to 100. (The majority of M1 courses at each school were included because they met these criteria.)

Examples of selected courses included: biochemistry, cell and molecular biology, cardiovascular and pulmonary systems, behavioral medicine and health, health care ethics, introduction to clinical anatomy, and community engagement. Although the selected courses varied widely in the extent to which they related to the knowledge and skills tested on the MCAT exam, most taught natural sciences subjects. For each selected course, we analyzed one primary outcome. Some were weighted averages of students' performance on multiple assessments given throughout the course. Others were based on students' performance on the final exam. Because the courses selected by each validity school comprised the majority of M1 courses at the school, students' average performance in these courses served as a measure of their summative performance in their first-year coursework.

On-time progression to M2. We generated this progression outcome based on student enrollment records submitted by the registrars of the 145 accredited U.S. MD-granting schools. Students were categorized into 2 groups: those who experienced on-time progression to M2 and those who did not, according to their school's curriculum. This outcome allowed us to study each student's performance defined by her or his sufficient mastery of the curriculum to progress on time to the next year. We analyzed progression data for all students in regular MD programs. Students in dual degree programs were excluded from the analysis.

Predictors

Total scores from the new MCAT exam and UGPAs were used as predictors.

MCAT total scores. The new MCAT exam has 4 sections: (1) Biological and Biochemical Foundations of Living Systems; (2) Chemical and Physical Foundations of Biological Systems; (3) Psychological, Social, and Biological Foundations of Behavior; and (4) Critical Analysis and Reasoning Skills. The first 3 sections test 10 foundational concepts and 4 scientific inquiry and reasoning skills in the natural, behavioral, and social sciences. The fourth section tests how well test takers comprehend, analyze, and evaluate what they read, draw inferences from text, and apply arguments to new ideas and situations.¹³ The new MCAT exam reports 4 section scores and a total score. The 4 section scores range from 118 to 132, with a midpoint at 125. The total score is the sum of the 4 section scores, with a range from 472 to 528 and a midpoint at 500.

Total UGPAs. Total UGPAs came from either the application service used by the validity school (i.e., the American Medical College Application Service, the Texas Medical and Dental School Application Service) or from the validity school itself for the 2 Canadian schools that did not use an external application service. In all cases, UGPAs were verified and standardized by the application services or the validity schools to allow medical schools to compare the academic experiences of applicants from undergraduate institutions that used different academic calendars and grading systems.^{14,15} UGPAs ranged from 0 to 4 for all but one validity school in Canada, which calculated students' UGPAs on a 0–100 scale.

Data analysis

Research question 1. To address the first research question about the extent to which MCAT scores predict students' M1 performance, we correlated MCAT total scores with validity school students' summative performance across M1 courses. These analyses were conducted by school to control for differences across schools in the course outcomes used to generate the summative performance outcome. The validity coefficients presented in this report represent the correlations of MCAT total scores with summative performance in M1 after correcting for range restriction in MCAT total scores and UGPAs due to student selection in the admissions process (see the Figure 1 legend for more details).¹⁶

Correlation coefficients can range from 0 (no relationship) to ± 1 (perfect positive/negative relationship).¹⁷ We present medians and interquartile ranges to summarize validity coefficients across schools.¹⁸

We also calculated the percentages of medical students in the national sample who achieved on-time progression to M2, using different ranges of MCAT total scores.

Research question 2. To address the second research question about the value of MCAT total scores and UGPAs, alone and together, in predicting students' summative performance in M1, we conducted 3 sets of regression analyses: Model 1: MCAT total score as the only predictor, Model 2: UGPA as the only predictor, and Model 3: both MCAT total score and UGPA as predictors.

We conducted the regressions by school and corrected the resulting correlations

for range restriction in the validity sample compared with each school's applicant population (see the Figure 3 legend for more details).¹⁶ We present the medians and interquartile ranges of the validity coefficients of the predictor(s) with the outcome,¹⁸ along with the percentage of variance in the outcome explained by the predictor(s).

Research question 3. We used well-established regression procedures^{4,12} to address the research question about whether MCAT scores provided comparable prediction of performance for students from different sociodemographic backgrounds, conducting analyses by race/ethnicity, highest parental education, and gender.^{19–21}

For each sociodemographic variable, students were divided into 2 groups. For race/ethnicity, students who self-identified as black or African American; Hispanic, Latino, or Spanish; American Indian or Alaska Native; or Native Hawaiian or other Pacific Islander

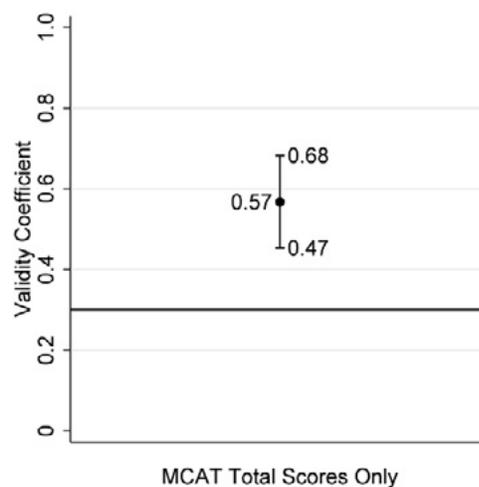


Figure 1 Median and interquartile range of the corrected correlations of Medical College Admission Test (MCAT) total scores with students' summative performance in the first year of medical school (M1). Summative performance is the mean of students' scores from the M1 courses that each validity school selected to include in this study. Summative performance showed a strong correlation (above 0.90) with students' official end-of-year performance, such as their M1 grade point average (GPA) or M1 class rank. The observed correlations were corrected for range restriction in MCAT total scores and undergraduate GPAs (UGPAs) due to student selection in the admissions process.¹⁶ The correlation correction adjusted for the differences in the standard deviations of MCAT scores and UGPAs in each school's validity sample compared with the school's applicant pool while accounting for the correlations among MCAT scores, UGPAs, and the outcome in the validity sample. Because more 2017 applicants than 2016 applicants to the validity schools had scores from the new exam, the corrections for range restriction were made using data from the 2017 admissions cycle. The corrected correlation coefficients (validity coefficients) are presented. The number next to the solid circle shows the median correlation. The numbers at the ends of the interquartile range show the correlation at the 25th (lower end) and 75th (higher end) percentiles of the distribution of corrected correlation coefficients, respectively. The horizontal line with a Y axis value at 0.3 is the reference line for a medium association.¹⁷ See Supplemental Digital Appendix 1 at <http://links.lww.com/ACADMED/A731> for the observed correlations.

were categorized as underrepresented in medicine (URM).²² Students who self-identified as white or Asian were categorized as non-URM.

Highest parental education was used as a proxy for students' socioeconomic backgrounds because of the close relationship between education level and income.²³ Students were categorized into 2 groups based on parental attainment of a bachelor's degree. One group included students who reported their parents did not have a bachelor's degree. The other included students who reported that at least one parent had a bachelor's degree.

The third sociodemographic group was based on self-reported gender. One group included female students, and the other included male students.

We compared the degree to which MCAT total scores predicted summative performance in M1 and on-time progression to M2 by race/ethnicity, parental education, and gender. We conducted 3 sets of linear regression analyses for summative performance in M1 and 3 sets of logistic regression analyses for on-time progression to M2.

We used the estimated regression parameters from each regression analysis to generate the predicted outcome for each student. We then computed the average observed and predicted outcomes separately for all students included in a sociodemographic group. We tested whether the mean residual, that is, the difference between the average observed and predicted outcomes, differed from zero. We also computed the effect size associated with each residual to estimate the magnitude of prediction error. These effect sizes are measures of the magnitude of prediction error. An effect size of 0.2 is considered small.²⁴ Prediction error with an effect size less than 0.2 means the difference between the average observed and predicted outcomes is trivial and of no practical importance. All analyses were conducted using Stata (version 14; StataCorp, College Station, Texas).

Results

Characteristics of participants and outcomes

Students in the validity sample were similar to the national population of medical students with scores from

the new MCAT exam based on most sociodemographic characteristics. Slightly larger percentages of students received fee assistance from the AAMC and identified as black or African American in the validity sample than in the national population. The validity sample and the national population had similar means and standard deviations (SDs) of MCAT total scores (Mean_{sample} = 507.87, SD = 7.34; Mean_{population} = 508.57, SD = 6.92; see Table 1). Both the validity sample and the national population had a mean UGPA of 3.70 (SD = 0.25).

Summative performance in M1

Figure 1 shows the median and interquartile range of the correlations of MCAT total scores with students' summative performance in M1. The median correlation was 0.57, and the 25th and 75th percentiles were 0.47 and 0.68, respectively.

On-time progression to M2 by MCAT total scores

Figure 2 shows the percentages of students in the national population who progressed to M2 on time by different ranges of MCAT total scores. Overall, the vast majority (7,736; 97%) of these students progressed on time, and the progression rate for students across a wide range of MCAT total scores was high.

The percentage of students who progressed on time was 93% or above for those students with MCAT total scores from 494 to 528. Less than 2% (N = 131) of the national population reported scores below 494. The number of students with scores below 494 was too small to interpret meaningful differences in their progression rate compared with those who scored at or above 494.

Value of MCAT total scores and UGPAs in predicting students' summative performance in M1

Figure 3 shows the medians and interquartile ranges of the correlations of MCAT total scores (Panel A), UGPAs (Panel B), and MCAT total scores and UGPAs together (Panel C) with students' summative performance in M1.

As described previously, the median correlation of MCAT total scores with summative performance in M1 was 0.57, and the 25th and 75th percentiles were

0.47 and 0.68, respectively. The median correlation of UGPAs with summative performance in M1 was 0.52, and the 25th and 75th percentiles were 0.42 and 0.62, respectively. The results for MCAT total scores were similar to those for UGPAs, but the median and interquartile range for MCAT total scores were slightly higher than those for UGPAs. When using both MCAT total scores and UGPAs to predict summative performance in M1, the median correlation was 0.65, with an interquartile range of 0.56–0.79.

Using MCAT scores and UGPAs together explained a much greater percentage of the variance in students' summative performance in M1 than using UGPAs alone. The percentage of variance explained by MCAT scores and UGPAs together based on the median validity coefficient (42%) was 1.6 times the percentage of variance explained by UGPAs alone (27%). These results show that, together, MCAT total scores and UGPAs provided stronger prediction of students' summative performance in M1 than either predictor alone.

Predicting performance for students from different sociodemographic backgrounds

Table 2 shows the observed and predicted performance outcomes for students by race/ethnicity, highest parental education, and gender; the differences between the observed and predicted outcomes; and the effect sizes associated with those differences.

In the validity sample, the differences between the observed and predicted outcomes of summative performance in M1 were minor for students by race/ethnicity, parental education, and gender. None of the mean differences were statistically significant. The magnitudes of these differences were also of no practical importance. For example, the mean difference between the observed and predicted performance for students identified as URM was -0.38 (on a 0–100 scale), with an effect size of -0.07 . The mean difference for students whose parents did not have a bachelor's degree was -0.09 , with an effect size of -0.02 . The mean difference for female students was 0.13, with an effect size of 0.03.

In the national population, there were either no differences or only minor ones between the observed and predicted

Table 1

Demographic Characteristics of the Validity Sample and the National Population of 2016 Medical School Matriculants With Scores From the New MCAT Exam Who Were Included in an Analysis of the Validity of Scores From the New MCAT Exam in Predicting Student Performance

Characteristic	Validity sample ^a	National population of 2016 matriculants ^b
Medical students, total no.	955	7,970
Medical students by gender, no. (%)^c		
Male	417 (44)	3,655 (46)
Female	538 (56)	4,313 (54)
Medical students who received fee assistance from the AAMC, no. (%)	94 (10)	546 (7)
Medical students by self-reported race/ethnicity, no. (%)^d		
White	497 (53)	4,541 (57)
Black or African American	178 (19)	939 (12)
Hispanic, Latino, or Spanish	80 (9)	967 (12)
Asian	175 (19)	1,288 (16)
American Indian or Alaska Native, Native Hawaiian or other Pacific Islander	13 (1)	116 (1)
Other	20 (2)	256 (3)
MCAT total score, mean (SD)^e	507.87 (7.34)	508.57 (6.92)
Total undergraduate GPA, mean (SD)^f	3.70 (0.25) ^g	3.70 (0.25)

Abbreviations: MCAT indicates Medical College Admission Test; AAMC, Association of American Medical Colleges; SD, standard deviation; and GPA, grade point average.

^aThe validity sample consisted of 2016 matriculants enrolled in one of the 16 medical schools participating in the MCAT validity research who volunteered to participate in this study. The 2016 matriculants at these schools were provided detailed information about the research. Those who volunteered for the study signed consent forms to allow their school to share their course-based and year-end outcomes with the AAMC for research purposes. The total number of students who matriculated at the validity schools in 2016 was 2,541. About half of them (1,199; 47%) applied with scores from the new MCAT exam. The participation rate in this study was at or above 75% at the majority of validity schools. In total, 955 matriculants with scores from the new MCAT exam were included in this study. The 16 validity schools included in this study are a subset of the 18 medical schools partnering with the AAMC on the MCAT validity research and include Boston University School of Medicine, Columbia University Vagelos College of Physicians and Surgeons, East Tennessee State University James H. Quillen College of Medicine, Meharry Medical College, Memorial University of Newfoundland Faculty of Medicine, Morehouse School of Medicine, Philadelphia College of Osteopathic Medicine, Rutgers Robert Wood Johnson Medical School, Saint Louis University School of Medicine, The Ohio State University College of Medicine, Tulane University School of Medicine, Uniformed Services University of the Health Sciences F. Edward Hébert School of Medicine, University of Arizona College of Medicine–Tucson, University of Calgary Cumming School of Medicine, University of California, San Francisco, School of Medicine, The University of Illinois College of Medicine–Chicago, University of Mississippi School of Medicine, and University of Texas School of Medicine at San Antonio. These 18 schools were carefully selected from 65 medical schools that volunteered to partner with the AAMC on the MCAT validity research. Validity schools represent schools with a wide range of missions, regions, and other school and student characteristics.

^bThe national population includes 2016 medical school matriculants who applied with scores from the new MCAT exam and were included in this study. Students enrolled in MD/PhD or other dual degree programs were excluded from the analysis due to the planned delay in graduation.

^cDuring the 2016 application cycle, there were only 2 options available for gender.

^dStudents identified their racial/ethnic backgrounds when they registered for the MCAT exam or applied to medical school through the American Medical College Application Service (AMCAS). Students may select as many races/ethnicities as they wish. The percentage of individuals reporting race/ethnicity, as well as the combinations reported, have been stable in recent years.³⁰ Percentages were calculated based on the individuals who provided race/ethnicity information. Percentages add up to more than 100% because racial/ethnic minority results include individuals who may have designated more than one race/ethnicity.

^eThe most recent MCAT scores available were used in this study to capture all the knowledge and skills students gained before their last attempt at the MCAT exam.

^fPostbaccalaureate undergraduate course grades were included in the calculation of the total cumulative undergraduate GPAs for medical schools that use AMCAS.

^gUndergraduate GPAs ranged from 0 to 4 for all except one validity school in Canada, which calculated students' undergraduate GPAs on a 0–100 scale. The actual GPAs for students from this school ranged from 75.47 to 95.00 and had an average of 83.83 (SD = 4.13).

outcomes of on-time progression to M2 for students by race/ethnicity, highest parental education, and gender. No differences were statistically or

practically significant. For instance, 95% of students identified as URM were predicted to progress on time compared with 94% who did. The observed

progression rates were the same as the predicted rates for medical students whose parents did not have a bachelor's degree (96%). Similarly, female students had the same observed and predicted progression rates (96%).

Together, these results showed that medical students from different sociodemographic backgrounds performed, on average, at the levels that their MCAT scores predicted they would across their M1 courses and in their on-time progression to M2.

Discussion

Our study is the first multisite evaluation of the validity of scores from the new MCAT exam in predicting student performance in medical school, focusing on performance in M1. It is also the first study to assess whether scores from the new exam provide comparable prediction of performance in M1 for students from different sociodemographic backgrounds. Summative performance across selected M1 courses and on-time progression to M2 were used as outcomes.

The correlations of MCAT total scores with summative performance in M1 ranged from medium to large across the validity schools included in this study. These findings are important. Knowing that MCAT scores provide valid information about applicants' readiness for medical school can give admissions committees the flexibility to select applicants who are academically prepared for medical school while taking into account the number of students they have the resources to support.

The predictive validity findings from our study are consistent with the findings from previous large-scale, multicohort studies on the predictive validity of scores from the old MCAT exam.⁵ They are also consistent with findings about the validity of scores from admission exams for other graduate or professional school programs, such as the Law School Admission Test¹⁸ and the Graduate Management Admission Test,²⁵ which show medium to large correlations with first-year performance.

Our study also showed that overall, students with a wide range of MCAT total scores progressed to M2 on time. This outcome is important because it

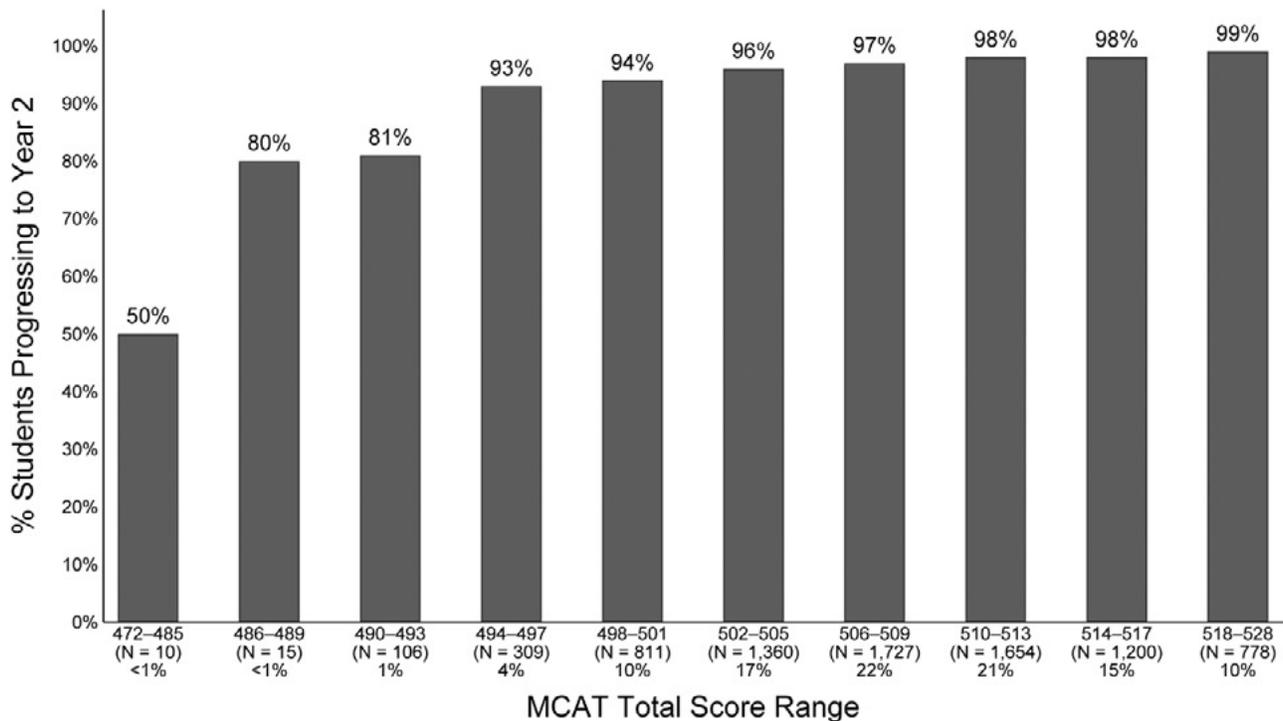


Figure 2 Percentage of the 2016 cohort of medical school matriculants with scores from the new Medical College Admission Test (MCAT) who progressed to year 2 of medical school on time, by MCAT total score range. In total, 7,970 students in the national population of 2016 matriculants with scores from the new MCAT exam were included in the analysis. Students enrolled in MD/PhD or other dual degree programs were not included due to the planned delay in graduation. Less than 2% (N = 131) of the national population reported MCAT scores below 494; in this group, the on-time progression rate was 79%. The numbers of students in the score ranges below 494 are too small to interpret meaningful differences in their progression rates compared with those with scores at or above 494. On-time progression rates are based on observed progression for those students who were admitted to medical school and do not reflect the potential performance of those who were not accepted. Additionally, multiple factors may contribute to the lack of on-time progression, including a possible combination of academic and nonacademic reasons.

represents the first milestone toward graduating within the typical time frame based on each school's curriculum. The finding that students with a wide range of MCAT total scores progressed to M2 on time suggests that medical school admissions committees are admitting applicants with the academic qualifications and demonstrated excellence in domains important for success in medical school and supporting those students when they enter.²⁶

Also important is learning that using MCAT scores and UGPAs together provided better prediction of M1 performance than using either alone. The median correlation of each academic metric with students' summative M1 performance was greater than 0.50. When used together, the median correlation increased to 0.65. This finding supports the common practice of using both metrics for admissions decisions²⁶ and is consistent with professional testing standards and guidance on using MCAT scores in student selection.^{4,13}

Our results also showed that MCAT total scores provided comparable prediction of performance in M1 for students from different sociodemographic backgrounds. The differences between observed and predicted performance on both outcomes we studied were of neither statistical significance nor practical importance. Evidence of comparability in prediction addresses professional testing standards related to the fairness of test scores used in admissions decision making.⁴

Results from our study suggest that MCAT scores provide useful information about student performance in the first year of medical school. The results from the validity schools are generalizable to 2016 matriculants at other medical schools in North America because the students in the validity sample were representative demographically of the national population of 2016 medical school matriculants with scores from the new MCAT exam and their schools were carefully selected for the validity research to represent a diverse pool of medical schools in North America.

Our study has several limitations. It is based on data from the first cohort of medical students admitted with scores from the new MCAT exam. Nationally, these students represent about 40% of the entire 2016 cohort of medical school matriculants. By comparison, almost 90% of 2017 matriculants applied with scores from the new exam. Consequently, the number of matriculants in each specific URM group (e.g., black or African American) in the 2016 cohort was smaller than it would be during a typical application year, when all applicants take the same version of the MCAT exam. Therefore, in this first validity study of scores from the new exam, we did not examine whether MCAT total scores provided comparable prediction for each specific URM group. Future research will continue addressing the comparability of MCAT scores as more data become available.

In addition, our study examined MCAT scores in relation to student performance in the first year of medical school. This outcome is the closest chronologically to

Table 2

Comparison of Observed and Predicted Performance for 2016 Medical School Matriculants From Different Sociodemographic Backgrounds Who Took the New MCAT Exam

Outcome	Sociodemographic variable	Student groups	No. students	Observed summative performance in M1		Predicted summative performance in M1		Difference	Effect size ^e
				Mean	SD	Mean	SD		
Summative performance in M1 (validity sample)	Racial/ethnic identity ^{a,b}	Non-URM	596	84.54	5.85	84.37	3.77	0.17	0.03
		URM	261	82.83	6.88	83.21	3.21	-0.38	-0.07
	Highest parental education ^{c,d}	At least one parent with a bachelor's degree	609	84.99	6.07	84.96	3.64	0.03	0
		No parent with a bachelor's degree	149	83.87	7.00	83.96	3.91	-0.09	-0.02
	Gender	Male	417	84.37	6.63	84.54	3.92	-0.17	-0.04
		Female	538	84.17	5.84	84.04	3.56	0.13	0.03

Outcome	Sociodemographic variable	Student groups	No. students	Observed on-time progression to M2		Predicted on-time progression to M2		Difference	Effect size ^h
				No.	%	No.	%		
On-time progression to M2 (national population) ^f	Racial/ethnic identity ^a	Non-URM	5,774	5,636	98	5,615	97	1	0.06
		URM	1,952	1,830	94	1,850	95	-1	-0.04
	Highest parental education ^{c,g}	At least one parent with a bachelor's degree	6,325	6,134	97	6,125	97	0	0
		No parent with a bachelor's degree	1,411	1,351	96	1,352	96	0	0
	Gender	Male	3,655	3,543	97	3,541	97	0	0
		Female	4,313	4,157	96	4,159	96	0	0

Abbreviations: MCAT indicates Medical College Admission Test; M1, first year of medical school; SD, standard deviation; URM, underrepresented in medicine; M2, second year of medical school; AMCAS, American Medical College Application Service.

^aStudents were categorized into URM and non-URM groups based on their self-reported race/ethnicity.²² Students who self-identified as black or African American; Hispanic, Latino, or Spanish; American Indian or Alaska Native; or Native Hawaiian or other Pacific Islander were included in the URM group. Students who self-identified as white or Asian were included in the non-URM group.

^bThe analysis of summative performance in M1 by students' self-reported racial/ethnic identity was conducted based on data from 14 medical schools. It excluded students from 2 validity schools because these schools had no URM students who volunteered to participate in the study.

^cHighest parental education was used as a proxy measure of students' socioeconomic backgrounds because of the close relationship between education level and income.²³ Students were categorized into 2 groups based on parental attainment of a bachelor's degree. One group included students who self-reported that their parents did not have a bachelor's degree. The other included students who reported that at least one parent had a bachelor's degree.

^dAmong the validity sample, 197 students were excluded from the analysis because their parents' highest education was unavailable (e.g., students did not provide parental education information in their application, students' parents were deceased, students did not apply to medical schools through AMCAS).

^eThe effect size for the prediction error of summative performance mean scores was calculated as $g = \frac{\bar{x}_1 - \bar{x}_2}{s^*}$, where $s^* = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 + n_2 - 2)}}$. \bar{x}_1 represents the mean of observed summative performance in M1 for

students in a group (e.g., URM). \bar{x}_2 represents the mean of predicted summative performance in M1 for the same group. n_1 and n_2 are the same, representing the number of students in the group (e.g., URM). s_1 represents the SD of observed summative performance in M1 for the group. s_2 represents the standard deviation of predicted summative performance in M1 for the same group.³¹

^fFor the analysis of on-time progression to M2, the authors also tested the robustness of the findings through an alternative analysis approach. They randomly split the national population of 2016 matriculants with scores from the new MCAT exam into 2 groups. They used one group to conduct the regression analysis and used regression parameters from the regression group to generate predicted on-time progression to M2 for the other group. Results support the conclusion that MCAT total scores provide comparable prediction of on-time progression to M2 for students from different sociodemographic backgrounds.

^gAmong the national population, 234 students were excluded from the analysis because their parents' highest education was unavailable (e.g., students did not provide parental education information in their application, students' parents were deceased, students did not apply to medical schools through AMCAS).

^hThe effect size for the prediction error of on-time progression was calculated as

$h = 2(\arcsine(\sqrt{P_1}) - \arcsine(\sqrt{P_2}))$, where P_1 represents the observed percentage of students who progressed to M2 on time for students in a group (e.g., URM) and P_2 represents the predicted percentage of students who progressed to M2 on time for students in the same group.²⁴

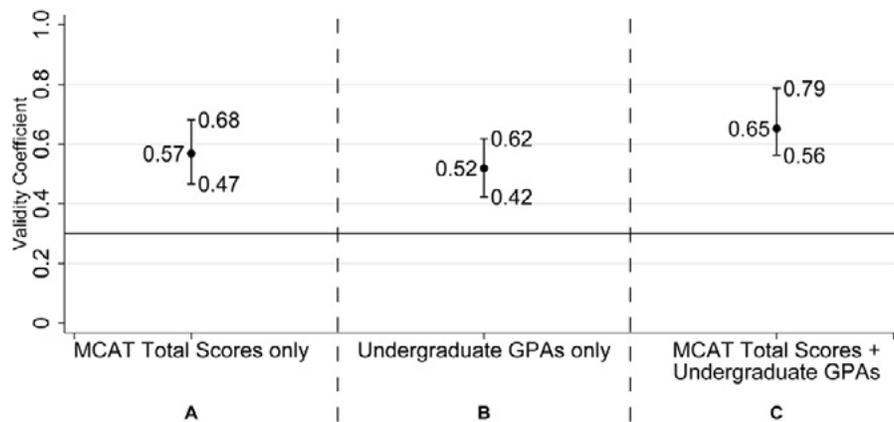


Figure 3 Medians and interquartile ranges of corrected correlations of new Medical College Admission Test (MCAT) total scores and undergraduate grade point averages (UGPAs), alone (Panels A and B) and together (Panel C), with students' summative performance in the first year of medical school (M1). Summative performance is the mean of students' scores from the M1 courses that each validity school selected to include in this study. Summative performance showed a strong correlation (above 0.90) with students' official end-of-year performance, such as their M1 GPA or M1 class rank. The observed correlations were corrected for range restriction in MCAT total scores and UGPAs due to student selection in the admissions process.¹⁶ The correlation correction adjusted for the differences in the standard deviations of MCAT scores and UGPAs in each school's validity sample compared with the school's applicant pool, while accounting for the correlations among MCAT scores, UGPAs, and the outcome in the validity sample. Because more 2017 applicants than 2016 applicants to the validity schools had scores from the new exam, the corrections for range restriction were made using data from the 2017 admissions cycle. The corrected correlation coefficients (validity coefficients) are presented. The numbers next to the solid circles show the median correlations. The numbers at the ends of the interquartile ranges show the correlations at the 25th (lower end) and 75th (higher end) percentiles of the distribution of corrected correlation coefficients, respectively. The horizontal line with a Y axis value at 0.3 is the reference line for a medium association.¹⁷ See Supplemental Digital Appendix 1 at <http://links.lww.com/ACADMED/A731> for the observed correlations.

MCAT scores. It comes from courses that probably have more concepts in common with those tested on the MCAT exam than courses in the later years of medical school, as the MCAT exam was designed to measure the foundational natural, behavioral, and social science concepts upon which the preclerkship years of the medical school curriculum are built.

Much remains to be learned about how students fare during the rest of their preclerkship and clerkship coursework, on the USMLE Step exams, and on other more distant and comprehensive outcomes, as well as for entering classes for which all students were admitted with scores from the same version of the MCAT exam. There is also more to learn about the value of MCAT scores in predicting performance for students at medical schools that vary in their missions, admission practices, curricular structures (e.g., discipline vs systems based), instructional approaches, and the types and amounts of support provided to students.²⁷⁻²⁹ In addition, there is great interest in learning how MCAT section scores predict performance in different subject areas, as well as how the old and new MCAT exams compare when predicting student performance in medical school. Future studies of the MVC will delve into these and other questions.

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of American Medical Colleges' (AAMC's) Medical College Admission Test (MCAT) Validity Research Study protocol and (2) the participating medical schools' MCAT Validity Study protocol. Course-based outcome data for the validity sample used in this report came from 16 medical schools that partner with the AAMC on MCAT validity research. All validity schools granted permission to the AAMC to use the data in MCAT validity research and publications. Representatives from the validity schools were also provided the opportunity to review the manuscript before its submission for publication.

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Investigating Group Differences in Examinees' Preparation for and Performance on the New MCAT Exam

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Abstract

In 2015, the Medical College Admission Test (MCAT) was redesigned to better assess the concepts and reasoning skills students need to be ready for the medical school curriculum. During the new exam's design and rollout, careful attention was paid to the opportunities examinees had to learn the new content and their access to free and low-cost preparation resources. The design committee aimed to mitigate possible unintended effects of the redesign, specifically increasing historical mean group differences in MCAT scores for examinees from lower socioeconomic status (SES) backgrounds and races/

ethnicities underrepresented in medicine compared with those from higher SES backgrounds and races/ethnicities not underrepresented in medicine.

In this article, the authors describe the characteristics and scores of examinees who took the new MCAT exam in 2017 and compare those trends with historical ones from 2013, presenting evidence that the diversity and performance of examinees has remained stable even with the exam's redesign. They also describe the use of free and low-cost MCAT preparation resources and MCAT preparation courses for examinees from

higher and lower SES backgrounds and who are enrolled in undergraduate institutions with more and fewer resources, showing that examinees from lower SES backgrounds and who attend institutions with fewer resources use many free and low-cost test preparation resources at lower rates than their peers. The authors conclude with a description of the next phase of this research: to gather qualitative and quantitative data about the preparation strategies, barriers, and needs of all examinees, but especially those from lower SES and underrepresented racial/ethnic backgrounds.

Editor's Note: An Invited Commentary by R.M. Schwartzstein appears on pages 333–335.

Medical schools aim to admit diverse classes of students with the right mix of academic preparation, extracurricular experiences, and personal attributes needed for medical school. Classes with these characteristics enable medical schools to meet their missions and goals. For the past 90 years, the Medical College Admission Test (MCAT) has been used as one measure of academic preparation, assessing the scientific concepts and reasoning skills of entering medical students.

Advances in biomedical science and health care delivery require that physicians be capable of applying their scientific knowledge and reasoning skills

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to complex problems in clinical care and research for an increasingly diverse and aging patient population, and medical education is evolving to address these changes. But these changes also mean that medical students need a broader academic foundation to be prepared for today's medical school curriculum. To better assess the readiness of potential medical students, a new version of the MCAT exam was introduced in April 2015. The new exam requires multidisciplinary problem-solving and tests more subjects and greater scientific reasoning than the old exam did.¹

MCAT scores provide a common measure of academic preparation, in contrast with undergraduate grade point averages (UGPAs), which can vary by institution, major, and coursework.^{2,3} Historically, MCAT scores have predicted important student outcomes from entry through graduation from medical school.^{4–9} Although MCAT scores provide useful information about students' academic readiness for medical school, the average scores of applicants from lower socioeconomic status (SES) backgrounds and races/ethnicities underrepresented in medicine (URM) are lower than those of applicants from higher SES

backgrounds and races/ethnicities not underrepresented in medicine.^{10,11}

Research during the MCAT redesign process explored potential factors contributing to these historical group differences in MCAT scores. Davis and colleagues¹⁰ investigated the potential role of test bias, examining evidence that the exam meets professional testing standards for fairness in measurement quality and equitable treatment for examinees from different backgrounds.¹² They studied the steps taken to develop and administer the old exam (steps that are still taken for the new exam) to minimize the influence of irrelevant factors on scores and maximize the opportunities for examinees to demonstrate their preparation. Davis and colleagues presented evidence that scores from the old exam did not show predictive bias against black or Latino medical students because the success rates of students from these races/ethnicities were not higher than their scores predicted.

Davis and colleagues¹⁰ also reviewed extant research on the early connections between academic achievement and educational opportunities, environments, and experiences. For example, from an early age, factors like nutrition, day care quality, shared book reading with a family

member, and teacher quality in grade school and beyond are associated with academic achievement, enabling some students to maximize their potential, while limiting the potential of others. The authors saw that these factors varied systematically by medical students' racial/ethnic backgrounds and were correlated with achievement gaps between students from majority and minority backgrounds.

Even for medical school applicants, these factors seem salient, and in their research, Davis and colleagues¹⁰ found comparative trends in applicants' backgrounds. For example, applicants from URM racial/ethnic backgrounds were more likely to encounter factors shown to negatively affect academic achievement and were less likely to be exposed to positive factors. This research on the old MCAT exam suggested that group differences in MCAT scores likely stemmed from differences in examinees' environments, experiences, and opportunities rather than from technical deficiencies in the test itself.

The designers of the new MCAT exam considered this research on educational opportunities, socioeconomic backgrounds, and academic achievement, taking care not to introduce changes to the exam that would exacerbate existing group differences in MCAT scores. A central consideration in test blueprinting was examinees' opportunities to learn the concepts and skills tested on the exam, and blueprint decisions were informed by research on course availability and completion rates at undergraduate institutions, including minority-serving institutions.¹ Easy access to free or low-cost test preparation materials was a cornerstone of subsequent outreach campaigns to examinees and the advisors at their undergraduate institutions, with increased emphasis on venues and institutions serving examinees from lower SES and URM racial/ethnic backgrounds. All these efforts were aimed at mitigating the potential for different levels of access to accurate and timely information about the new MCAT exam while expanding the exam's focus to better align it with current medical school requirements.

Since research on the MCAT redesign addressed examinees' opportunities to learn and their ease of access to preparation resources, information about

their SES and undergraduate institutions also became central to subsequent MCAT validity research. It was important to know if examinees from lower SES backgrounds faced obstacles in their awareness of or ability to afford test preparation resources. Another potential roadblock was the undergraduate institution itself. Some institutions have fewer resources and could face challenges providing their students with the needed coursework and prehealth advising resources, potentially hindering students' access to coursework and other preparation materials needed for the new MCAT exam.

In this article, we provide the first national review of the characteristics and scores of examinees who took the new MCAT exam. We compare those trends with historical ones, presenting evidence about their stability in the face of the exam's redesign. We also look closely at the use of test preparation resources by examinees from different SES backgrounds and the resources of their undergraduate institutions. Exploration of these areas may reveal key points to guide future resource development and outreach strategies. We conclude with a description of the research underway to further understand the preparation needs of all examinees, but especially those from economically and educationally disadvantaged backgrounds.

Characteristics and Scores of Examinees Taking the New MCAT Exam

Students taking the new MCAT exam, especially those from lower SES or URM racial/ethnic backgrounds, had the potential to face new barriers, despite efforts to ensure equitable opportunities to learn the new content and equitable access to resources about the new exam. For example, real and perceived barriers in access to the coursework, textbooks, or other resources about the new content could have discouraged some groups of students from taking the exam, negatively affecting the diversity composition of the examinee population as a whole. Furthermore, real differences in access to learning resources could have increased historical differences in average MCAT scores for examinees from lower SES or URM racial/ethnic backgrounds compared with those from higher SES or non-URM racial/ethnic backgrounds.

To assess whether any of these scenarios occurred, we compared the characteristics and scores of examinees who took the new MCAT exam in 2017 with results from those who took the old exam in 2013 to look for decreases in diversity or increases in average group test score differences. We analyzed data from 2017 examinees (who took the new exam) because information about the concepts and skills tested on the new exam had been publicized for multiple years at that point, and many preparation resources were available. We analyzed data from 2013 examinees (who took the old exam) because they were not likely influenced by upcoming changes to the exam (in 2015), and anyone who wished to retake the test could have done so in 2014, while the old exam was still available.

We examined trends by gender, race/ethnicity, and SES as measured by participation in the Association of American Medical Colleges (AAMC) Fee Assistance Program (the only measure of SES available for both 2013 and 2017 examinees). We also studied trends based on the characteristics of examinees' undergraduate institutions, using data about selectivity in college admissions¹³ and the residential makeup of the campus (the percentage of undergraduate students who lived on campus and/or were enrolled full-time)¹⁴ as proxies for institutional resources. (Examinees whose institutions were missing information about selectivity or residential setting were excluded from this analysis.) This school resource variable included 2 levels: "more resources" and "fewer resources." Institutions with selective admissions practices and/or residential campuses were classified as having more resources. Institutions that employed the least selective admissions practices (they accepted students with a wide range of scores from college admissions tests) and had primarily nonresidential campuses (fewer than 25% of undergraduate students lived on campus and/or were enrolled full time) were classified as having fewer resources.

Compared with more selective institutions, less selective institutions tend to spend less money per student and have lower full-time to part-time faculty ratios and graduation rates.¹⁵ Primarily nonresidential schools are less likely to have faculty living near students or centrally located resources compared

with highly residential schools.^{16,17} The least selective institutions that predominately serve commuting students may lack robust prehealth advising resources to guide premedical students about the courses needed or the full range of resources available to help them prepare for the new exam. Students at these institutions also may have other responsibilities, including childcare and work, that interfere with the time they have to prepare for the exam.

Characteristics of MCAT examinees

Table 1 compares the characteristics of examinees who took the MCAT exam in 2017 with the characteristics of those who did so in 2013. Overall, these data show that the diversity of examinees did not change. In both years, the percentages of examinees identifying as black or African American, Hispanic, American Indian/Alaska Native, or Native Hawaiian/other Pacific Islander were similar, although in 2017, there was a small decrease (2.4%) in the percentage of examinees identifying as white or Caucasian. The percentages of examinees by the other characteristics were also similar in both years.

Although many differences were statistically significant, the only characteristic to show meaningful change was gender, with the percentage of females increasing from 50.9% in 2013 to 54.8% in 2017. Females have long outranked males in college enrollment, comprising 56% of undergraduate students in 2016.¹⁸ Compared with the 2013 examinees, the gender makeup of the 2017 examinees more closely resembled the makeup of undergraduate students.

Scores of MCAT examinees

Mean MCAT total scores were compared by these same examinee characteristics to assess group differences in scores from the new and old exams. For a given comparison (e.g., males versus females who took the new exam), the difference between the 2 mean scores was computed, and the magnitude of the difference was evaluated using the standardized mean difference (d). By convention, a $d = 0.2$ is considered a small difference, a $d = 0.5$ is considered medium, and a $d = 0.8$ is considered large.¹⁹

Table 2 compares the MCAT total scores of examinees who took the new exam in 2017 by gender, race/ethnicity,

participation in the AAMC Fee Assistance Program, and enrollment in institutions with more and fewer resources. It then compares these differences with those from 2013. These findings show that group differences in performance on the new exam are no larger than they were on the old exam.

The differences in average MCAT total scores from the new exam were small for males versus females ($d = 0.3$), for those who did not versus did participate in the AAMC Fee Assistance Program ($d = 0.4$), and for those who identified as white versus Native Hawaiian/other Pacific Islander ($d = 0.4$). The differences were medium for examinees who identified as white versus Hispanic ($d = 0.7$) and for those who identified as white versus American Indian/Alaska Native ($d = 0.6$). The differences were large for examinees who identified as white versus black or African American ($d = 0.9$) as well as for examinees attending institutions with more versus fewer resources ($d = 0.9$). These differences are very similar to the differences in scores from the 2013 examinees who took the old exam.

Notably, these mean differences in scores do not tell the whole story about the performance of examinees from different backgrounds. Figure 1 compares the distribution of MCAT total scores in 2017 by examinees' gender, race/ethnicity, participation in the AAMC Fee Assistance Program, and institutional resources. There is substantial overlap in the score distributions of examinees from different backgrounds, as well as substantial variation within each group. It is clear from Figure 1 that there were examinees with low, middle, and high MCAT total scores in each group.

In summary, the average differences in MCAT scores from the new exam were no larger than the differences in scores from the old exam. However, they also were no smaller. The desire to understand and potentially disrupt some of the factors that influenced these persistent differences was the genesis for the work described below.

Finding Points of Leverage in Test Preparation

Understanding examinees' use of test preparation resources and the barriers they face in accessing them may

reveal better ways to increase access to affordable resources that will support all examinees, but especially those from lower SES backgrounds. Our analysis focused on the use of test preparation resources based on examinees' SES and the resources of their undergraduate institutions. Differences in use based on these factors may signal the need for additional resources and refined outreach targeted to the unique needs of examinees of more limited means.

We examined survey data (see the Table 3 footnotes for a description of the surveys) about 2017 examinees' use of test preparation resources developed by the AAMC and their completion of university-based or commercial MCAT preparation courses, in relation to their SES and the resources of their undergraduate institutions. Examinees' SES was based on a combination of their parents' highest level of education and occupation (related to, but defined differently than, the Educational-Occupational indicator provided by the American Medical College Application Service²⁰). Examinees who had one or more parent with a bachelor's degree or who worked in a professional or managerial occupation were classified as "higher SES," and examinees whose parents did not have a bachelor's degree *and* who worked in a service or clerical occupation were classified as "lower SES."

Parental education and occupation are related to household income,²⁰⁻²³ and examinees who are the first in their families to complete college may not benefit from their parents' firsthand experiences on how to navigate or succeed in college or on graduate school or professional admissions tests (e.g., the MCAT, Law School Admission Test, or Graduate Management Admission Test).²⁴

We used the same measure of institutional resources as defined above (based on the selectivity and residential setting of examinees' undergraduate institutions), with examinees' undergraduate institutions being classified as having "more resources" or "fewer resources." Again, institutions with fewer resources may be less equipped to provide guidance about MCAT preparation tools than those with more resources. Examinees attending less-resourced institutions are also more likely to live at home, care for dependents, and

Table 1

Comparison of the Characteristics of Medical College Admission Test (MCAT) Examinees in 2017 (New Exam) Versus 2013 (Old Exam)^a

Characteristic ^b	% of examinees in 2017	% of examinees in 2013	Difference between % of examinees in 2017 versus 2013		No. of examinees in 2017	No. of examinees in 2013
			% difference	Cohen's <i>h</i> ^c		
Gender						
Male	45.2	49.1	-3.9 ^d	-0.08	36,534	40,851
Female	54.8	50.9	3.9 ^d	—	44,233	42,347
Race/ethnicity^e						
White	46.0	48.4	-2.4 ^d	-0.05	35,262	35,820
Black or African American	10.7	10.2	0.5 ^d	0.02	8,210	7,540
Hispanic, Latino, or Spanish	11.3	11.8	-0.5 ^d	-0.02	8,688	8,736
Asian	28.7	27.8	0.9 ^d	0.02	22,029	20,534
American Indian or Alaska Native	1.1	0.9	0.2 ^d	0.02	845	653
Native Hawaiian or other Pacific Islander	0.3	0.4	-0.1	-0.02	253	296
AAMC Fee Assistance Program^f						
Did not receive	92.3	93.0	-0.7 ^d	-0.03	63,790	65,891
Received	7.7	7.0	0.7 ^d	—	5,299	4,952
School resources^g						
More resources	95.6	95.6	0.0	0.00	64,499	66,031
Fewer resources	4.4	4.4	0.0	—	2,941	3,059

Abbreviation: AAMC indicates Association of American Medical Colleges.

^aPercentages are based on the number of unique examinees who responded to each question. Examinees who took the MCAT exam more than once were counted once in this table, using data from their most recent test administration. The total number of 2017 examinees was 80,997, and the total number of 2013 examinees was 83,276.

^bIn 2017, $N_{\text{Gender}} = 80,767$, $N_{\text{Race/Ethnicity}} = 76,737$, $N_{\text{AAMCFeeAssistance}} = 69,089$, $N_{\text{SchoolResources}} = 19,330$. In 2013, $N_{\text{Gender}} = 83,198$, $N_{\text{Race/Ethnicity}} = 73,989$, $N_{\text{AAMCFeeAssistance}} = 70,843$, $N_{\text{SchoolResources}} = 21,299$.

^cCohen's *h* is an effect size representing the standardized difference between 2 proportions. It allows for simple comparisons of the differences in proportions of examinees taking the exam in 2017 versus 2013. By convention, a $d = 0.2$ is considered a small difference, a $d = 0.5$ is considered medium, and a $d = 0.8$ is considered large.¹⁹

^dThese values are significant at $P < .006$, the critical P value after using the Bonferroni correction for the 9 χ^2 tests we conducted.

^eUnderrepresented in medicine race/ethnicity results include examinees who may have designated more than one race/ethnicity. Data for examinees who reported their race/ethnicity as "other" are not shown.

^fEligibility for the AAMC's Fee Assistance Program is limited to examinees who are U.S. citizens or permanent residents (or, for 2017 examinees, have Deferred Action for Childhood Arrivals status). Examinees who were neither U.S. citizens nor permanent residents were excluded from this analysis. A total of 11,981 examinees from 2017 and 12,470 from 2013 were excluded from this analysis because they were not U.S. citizens or permanent residents.

^gUndergraduate institutions were defined as having "more resources" or "fewer resources" using publicly available data about college selectivity¹³ and the residential makeup of the campus.¹⁴ Schools with more resources were those that were selective in their admissions practices (test score data for first-year students were in the middle two-fifths of selectivity among all baccalaureate institutions) or more selective in their admissions practices (test score data for first-year students were between the 80th and 100th percentile of selectivity among all baccalaureate institutions) or were primarily residential campuses (25%–49% of degree-seeking undergraduate students lived on campus and at least 50% attended full-time) or highly residential campuses (at least half of degree-seeking undergraduate students lived on campus and at least 80% attended full-time). Schools with fewer resources met 2 criteria: (1) had the least selective admissions practices (these institutions either did not report test score data or the test score data they did report indicated that they extend educational opportunity to a wide range of students with respect to academic preparation and achievement) and (2) had campuses that were primarily nonresidential (less than 25% of undergraduate students lived in institutionally owned, operated, or affiliated housing or fewer than 50% of degree-seeking undergraduate students attended full-time).

work to support their families.^{25–27} These additional barriers could affect their awareness of resources and their time for test preparation, above and beyond the challenges of affording preparation resources.

Table 3 compares the preparation practices of examinees from higher and lower SES backgrounds and those attending schools with more and fewer resources. It shows that examinees from lower SES backgrounds and those who attended schools with fewer resources used many of the free and

low-cost resources at lower rates than their counterparts. For example, fewer examinees from lower SES backgrounds than higher SES backgrounds used the AAMC online practice or sample test (72.3% versus 79.6%) or the AAMC online item banks (44.7% versus 52.3%). Smaller but significant differences were seen in the use of the AAMC's *Official Guide to the MCAT Exam*. The differences in the use of these preparation resources for students at institutions with more versus fewer resources were similar to the differences for students from higher versus lower SES backgrounds.

The percentage of examinees who used the Khan Academy MCAT collection was lower for examinees attending schools with fewer resources than for examinees attending schools with more resources (47.5% versus 53.5%) but not for examinees from lower versus higher SES backgrounds (52.4% versus 52.8%). The Khan Academy is a free, online resource with videos that teach and with multiple-choice questions that assess the concepts tested on the MCAT exam. The percentages of examinees who used the AAMC online interactive tool and the MCAT Flashcards were low and did not differ by SES or school resources.

Table 2

Comparison of Medical College Admission Test (MCAT) Total Scores for 2017 (New Exam) Versus 2013 (Old Exam), by Examinee Characteristics^a

Characteristic	MCAT total score in 2017, mean (SD)	MCAT total score in 2013, mean (SD)	Standardized mean difference (<i>d</i>) ^b		No. of examinees in 2017	No. of examinees in 2013	
			Comparison	<i>d</i> _{new}			<i>d</i> _{old}
Gender							
Male	503.1 (10.5)	26.7 (6.4)	—	—	36,534	40,851	
Female	500.2 (10.6)	24.5 (6.6)	Male-Female	0.3	0.3	44,233	42,347
Race/ethnicity^c							
White	503.3 (9.8)	26.7 (5.9)	—	—	35,262	35,820	
Black or African American	494.2 (9.8)	20.5 (6.3)	White-black or African American	0.9	1.0	8,210	7,540
Hispanic, Latino, or Spanish	496.7 (10.4)	22.0 (6.9)	White-Hispanic, Latino, or Spanish	0.7	0.8	8,688	8,736
Asian	503.1 (10.7)	26.3 (6.6)	White-Asian	<0.1	0.1	22,029	20,534
American Indian or Alaska Native	497.8 (9.9)	23.5 (6.1)	White-American Indian or Alaska Native	0.6	0.6	845	653
Native Hawaiian or other Pacific Islander	499.3 (10.1)	22.6 (6.8)	White-Native Hawaiian or other Pacific Islander	0.4	0.7	253	296
AAMC Fee Assistance Program^d							
Did not receive	501.8 (10.6)	25.7 (6.6)	—	—	63,790	65,891	
Received	497.2 (10.2)	22.9 (6.5)	Did not receive-Received	0.4	0.4	5,299	4,952
School resources^e							
More resources	502.1 (10.4)	25.9 (6.4)	—	—	64,499	66,031	
Fewer resources	492.3 (10.0)	19.9 (6.9)	More resources-Fewer resources	0.9	0.9	2,941	3,059

Abbreviations: AAMC indicates Association of American Medical Colleges; SD, standard deviation.

^aExaminees who took the MCAT exam more than once were counted once in this table, using data from their most recent test administration. The total number of 2017 examinees was 80,997, and the total number of 2013 examinees was 83,276.

^bThe standardized mean difference, or *d* statistic, allows for simple comparisons of the differences in scores on the new (2017) and old (2013) MCAT exams, which measure different concepts and are reported on different score scales, as well as comparisons to other standardized tests that differ more substantially from the MCAT exam. A *d* statistic describes the between-group difference relative to the pooled SD for the groups being compared. By convention, a *d* = 0.2 is considered a small difference, a *d* = 0.5 is considered medium, and a *d* = 0.8 is considered large.¹⁹ The formula used to generate the standardized mean differences is:

$d = (\text{mean}_{\text{Not Underrepresented}} - \text{mean}_{\text{Underrepresented}}) / \text{SD}_{\text{pooled}}$ where

$$\text{SD}_{\text{pooled}} = \sqrt{\frac{(N_{\text{Majority}} - 1)\text{var}_{\text{Not Underrepresented}} + (N_{\text{Underrepresented}} - 1)\text{var}_{\text{Underrepresented}}}{(N_{\text{Not Underrepresented}} - 1) + (N_{\text{Underrepresented}} - 1)}}$$

^cUnderrepresented in medicine race/ethnicity results include examinees who may have designated more than one race/ethnicity. Data for examinees who reported their race/ethnicity as “other” are not shown.

^dEligibility for the AAMC’s Fee Assistance Program is limited to examinees who are U.S. citizens or permanent residents (or, for 2017 examinees, have Deferred Action for Childhood Arrivals status). Examinees who were neither U.S. citizens nor permanent residents were excluded from the analysis. A total of 11,981 examinees from 2017 and 12,470 from 2013 were excluded from this analysis because they were not U.S. citizens or permanent residents.

^eUndergraduate institutions were defined as having “more resources” or “fewer resources” using publicly available data about college selectivity¹³ and the residential makeup of the campus.¹⁴ Schools with more resources were those that were selective in their admissions practices (test score data for first-year students were in the middle two-fifths of selectivity among all baccalaureate institutions) or more selective in their admissions practices (test score data for first-year students were between the 80th and 100th percentile of selectivity among all baccalaureate institutions) or were primarily residential campuses (25%–49% of degree-seeking undergraduate students lived on campus and at least 50% attended full-time) or highly residential campuses (at least half of degree-seeking undergraduate students lived on campus and at least 80% attended full-time). Schools with fewer resources met 2 criteria: (1) had the least selective admissions practices (these institutions either did not report test score data or the test score data they did report indicated that they extend educational opportunity to a wide range of students with respect to academic preparation and achievement) and (2) had campuses that were primarily nonresidential (less than 25% of undergraduate students lived in institutionally owned, operated, or affiliated housing or fewer than 50% of degree-seeking undergraduate students attended full-time).

Table 3 also shows completion rates for university-based or commercial MCAT preparation courses. Examinees from lower SES backgrounds were less likely to complete test preparation courses relative to those from higher SES backgrounds (38.1% versus 50.0%). The difference was smaller for examinees attending schools with fewer versus more resources (43.1% versus 48.7%), suggesting that

some students attending schools with fewer resources found ways to access preparation courses.

Conclusions

Overall, the diversity of the population who took the new MCAT exam in 2017 was similar to that of the population who took the old exam in 2013.

Likewise, the differences in average MCAT scores on the new exam were consistent with the differences in average scores on the old exam for examinees from different backgrounds and for those attending schools with different resource levels.

Although the new exam’s broader scope had the potential to alter the composition

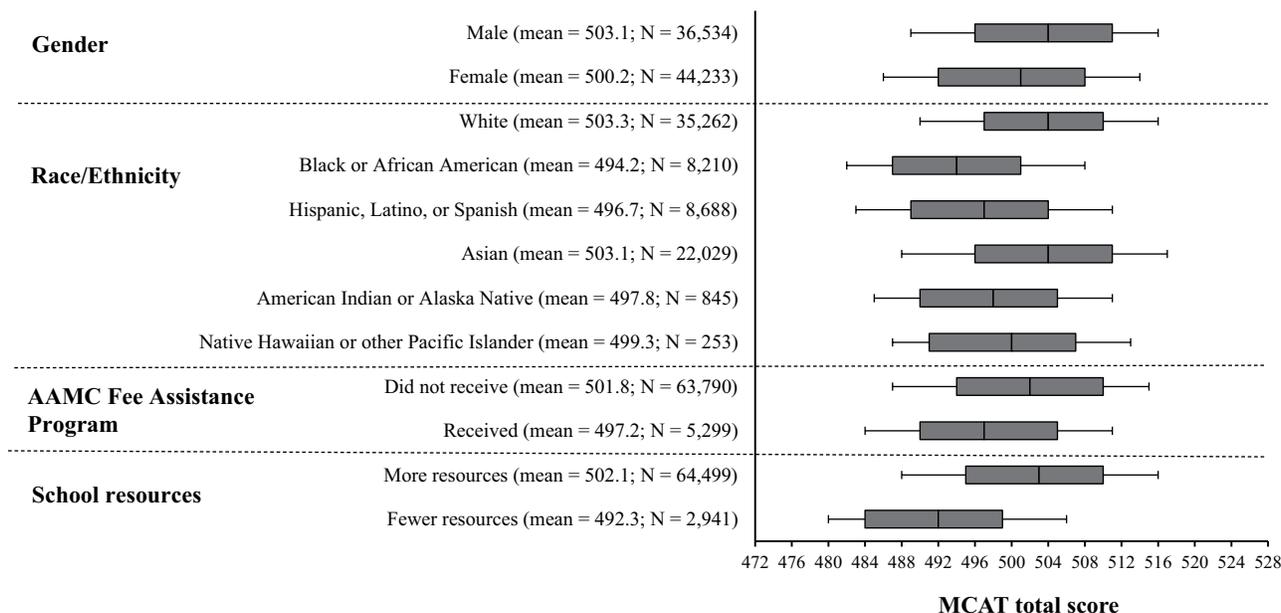


Figure 1 Distribution of Medical College Admission Test (MCAT) total scores in 2017, by examinee characteristics. Examinees who took the MCAT exam more than once were counted once, using data from their most recent test administration. Underrepresented in medicine race/ethnicity results include examinees who may have designated more than one race/ethnicity. Data for examinees who reported their race/ethnicity as “other” are not shown. Eligibility for the Association of American Medical Colleges (AAMC) Fee Assistance Program is limited to examinees who are U.S. citizens or permanent residents or have Deferred Action for Childhood Arrivals status. Undergraduate institutions were defined as having “more resources” or “fewer resources” using publicly available data about college selectivity¹³ and the residential makeup of the campus.¹⁴ Schools with more resources were those that were selective in their admissions practices (test score data for first-year students were in the middle two-fifths of selectivity among all baccalaureate institutions) or more selective in their admissions practices (test score data for first-year students were between the 80th and 100th percentile of selectivity among all baccalaureate institutions) or primarily residential campuses (25%–49% of degree-seeking undergraduate students lived on campus and at least 50% attended full-time) or highly residential campuses (at least half of degree-seeking undergraduate students lived on campus and at least 80% attended full time). Schools with fewer resources met 2 criteria: (1) had the least selective admissions practices (these institutions either did not report test score data or the test score data they did report indicated that they extend educational opportunity to a wide range of students with respect to academic preparation and achievement) and (2) had campuses that were primarily nonresidential (less than 25% of undergraduate students lived in institutionally owned, operated, or affiliated housing or fewer than 50% of degree-seeking students attended full-time).

of the examinee pool or increase group differences in scores among examinees from different backgrounds, there is no evidence that this occurred. Efforts to test concepts taught widely at undergraduate institutions and to provide equitable access to preparation resources may have mitigated the risk of increased group differences.

The group differences on the new MCAT exam that we did see paralleled the differences seen on other standardized undergraduate and graduate/professional school admissions tests.¹⁰ These differences were not limited to scores on standardized tests. Davis and colleagues showed that, even among medical school applicants, the mean differences in UGPAs by applicants’ race/ethnicity were consistent with those for MCAT scores.

Davis and colleagues also showed predictive validity findings suggesting that group differences in scores for students from different racial/

ethnic backgrounds were not due to technical deficiencies in the old MCAT exam but were likely linked to SES-related differences in environment and experiences that influenced those students’ academic achievements.¹⁰ Early predictive validity analyses of the first-year performance of medical students admitted with scores from the new MCAT exam showed findings similar to those from Davis and colleagues. That is, scores from the new exam did not show predictive bias because students from different backgrounds admitted to medical school with the same MCAT score achieved, on average, the same success in their first year of medical school.²⁸

We also looked at preparation specifically for the MCAT exam, focusing on examinees’ use of free and low-cost MCAT preparation resources as well as their completion of MCAT preparation courses. We found that examinees from lower SES backgrounds or who attended

schools with fewer resources reported using many of the AAMC’s free and low-cost resources at lower rates than their more advantaged counterparts.

Our work had several limitations, many of which can be addressed in future studies. Despite the apparent stability in examinee diversity and MCAT score differences across the transition from the old to the new MCAT exam, other factors could have confounded the interpretation of our findings, such as changes in aspiring applicants’ demographics, undergraduate enrollment, trends in undergraduate science education, medical school prerequisites, or other unmeasured factors that may have changed from 2013 to 2017. Another limitation relates to our measurement of SES using the parental income-based measure of examinees’ participation in the AAMC Fee Assistance Program, as we did for our analysis of 2013 and 2017 examinees’ diversity characteristics and

Table 3

Comparison of the Test Preparation Resources Used By Medical College Admission Test (MCAT) Examinees in 2017, by Socioeconomic Status (SES) and Undergraduate Institution Resources^a

Type of preparation resource	Cost	% of examinees from higher SES ^b	% of examinees from lower SES ^b	Difference between examinees by SES % difference	Cohen's <i>h</i> ^c	% of examinees from schools with more resources ^d	% of examinees from schools with fewer resources ^d	Difference between % of examinees by school resources % difference	Cohen's <i>h</i> ^e
Learn what is tested on the exam									
AAMC online interactive tool ^f	Free	17.9	17.7	0.2	0.01	18.0	15.4	2.6	0.07
Official Guide to the MCAT Exam (paper or electronic) ^f	Low cost	45.9	41.7	4.2 ^g	0.08	47.8	42.5	5.3	0.11
Study the concepts and skills									
Khan Academy MCAT collection ^h	Free	52.8	52.4	0.4	0.01	53.5	47.5	6.0 ^g	0.12
Practice taking multiple-choice items									
AAMC Flashcards ⁱ	Low cost	19.1	21.2	-2.1	-0.07	19.7	21.5	-1.8	-0.05
AAMC online practice or sample test ⁱ	Low cost	79.6	72.3	7.3 ^g	0.17	80.4	69.4	11.0 ^g	0.26
AAMC online item banks (question packs or section bank) ⁱ	Low cost	52.3	44.7	7.6 ^g	0.15	53.7	42.8	10.9 ^g	0.22
Learn, study, practice									
University-based or commercial MCAT prep course ^j	High cost	50.0	38.1	11.9 ^g	0.24	48.7	43.1	4.6 ^g	0.11

Abbreviation: AAMC indicates Association of American Medical Colleges.

^aPercentages are based on the number of unique examinees who responded to each question. Examinees who took the MCAT exam more than once were counted once in this table, using data from their most recent test administration. The analyses of the use of free and low-cost preparation resources provided by the AAMC excluded data for examinees participating in the AAMC's Fee Assistance Program because these students receive these resources for free and receive more frequent communications from the AAMC about their availability; thus, their awareness of and access to these resources may be greater than other examinees and may cloud any interpretation of the differences in use for examinees from different backgrounds. The analyses of the use of university-based or commercial MCAT preparation courses included data for all examinees who reported whether they took a MCAT preparation course, including participants in the AAMC's Fee Assistance Program.

^bThe "higher SES" variable was defined as those examinees having one or both of the following characteristics: (1) highest parental education was a bachelor's degree or higher and/or (2) highest parental occupation was professional or managerial. The "lower SES" variable was defined as those examinees reporting the following: highest parental education was no bachelor's degree and highest parental occupation was a service, clerical, skilled, or unskilled labor occupation. This variable was defined slightly differently than the levels of the SES indicator (Education-Occupation or EO indicator) in the American Medical College Application Service (AMCAS) because the EO level in AMCAS identifies students whose highest parental education is no bachelor's degree (irrespective of parental occupation), whereas the "lower SES" level in this study identifies the subset of examinees whose highest parental education is no bachelor's degree and whose parents' highest occupation level is a service, clerical, skilled, or unskilled labor occupation. Additionally, examinees provide less information about their parents when registering for the MCAT exam than they do in their medical school applications, contributing to other more minor differences between the EO indicator in AMCAS and the SES variable in this analysis. The number of Post-MCAT Questionnaire (PMQ) (see below) respondents for each condition was as follows: higher SES (N = 19,241) and lower SES (N = 2,038). Number of End-of-Day Survey (see below) respondents for each condition was as follows: higher SES (N = 55,911) and lower SES (N = 7,712).

^cCohen's *h* is an effect size representing the standardized difference between 2 proportions. It allows for simple comparisons of the differences in proportions of examinees with higher SES versus lower SES. By convention, a *d* = 0.2 is considered a small difference, a *d* = 0.5 is considered medium, and a *d* = 0.8 is considered large.¹⁹

^dUndergraduate institutions were defined as having "more resources" or "fewer resources" using publicly available data about college selectivity¹³ and the residential makeup of the campus.¹⁴ Schools with more resources were those that were selective in their admissions practices (test score data for first-year students were in the middle two-fifths of selectivity among all baccalaureate institutions) or more selective in their admissions practices (test score data for first-year students were between the 80th and 100th percentile of selectivity among all baccalaureate institutions) or were primarily residential campuses (25%–49% of degree-seeking undergraduate students lived on campus and at least 50% attended full-time) or highly residential campuses (at least half of degree-seeking undergraduate students lived on campus and at least 80% attended full-time). Schools with fewer resources met 2 criteria: (1) had the least selective admissions practices (these institutions either did not report test score data or the test score data they did report indicated that they extend educational opportunity to a wide range of students with respect to academic preparation and achievement) and (2) had campuses that were primarily nonresidential (less than 25% of undergraduate students lived in institutionally owned, operated, or affiliated housing or fewer than 50% of degree-seeking undergraduate students attended full-time). The number of PMQ respondents for each condition was as follows: more resources (N = 22,234) and fewer resources (N = 934). The number of End-of-Day Survey respondents for each condition was as follows: more resources (N = 63,277) and fewer resources (N = 2,883).

^eCohen's *h* is an effect size representing the standardized difference between 2 proportions. It allows for simple comparisons of the differences in proportions of examinees at schools with more resources versus fewer resources. By convention, a *d* = 0.2 is considered a small difference, a *d* = 0.5 is considered medium, and a *d* = 0.8 is considered large.¹⁹

^fData were from the PMQ. This survey is administered after test day and examinees are allowed approximately 3 weeks to provide responses. Examinees may participate in the PMQ each time they take the MCAT exam. PMQ data were only included for the PMQ administration associated with an examinee's most recent MCAT score. About 34% of 2017 examinees completed the survey. Responses were to the survey question: What kinds of resources did you use to prepare for the MCAT exam? PMQ participants may select any combination of responses.

^gThese values were significant at $P < .007$, their critical *P* value after using the Bonferroni correction for the 7 χ^2 tests we conducted.

^hData were from the End-of-Day Survey. This survey is administered at the end of test day, and about 98% of 2017 examinees responded to the question: How did you prepare for the examination you took today?

MCAT scores. We think that measuring SES using parental education and occupation, as we did to compare the preparation of 2017 examinees from lower and higher SES backgrounds, improves upon the income-based measure and should be replicated in future studies. In addition, findings for examinees attending institutions with more versus fewer resources should be replicated in future research because our use of institutional selectivity and residential setting as indicators of school resources is novel, and aggregate findings for an institution can mask dissimilarities in programs, enrollment patterns, and other factors potentially associated with the preparation patterns we examined here.¹⁴

Next Steps

In this article, we aimed to expand understanding of examinees' preparation for and performance on the MCAT exam by analyzing the test preparation of examinees from different backgrounds and who attend different types of undergraduate institutions. Thinking about the needs of students whose parents did not have a bachelor's degree or who attended a school with fewer resources may provide opportunities to increase access to information and resources about the MCAT exam.

Many factors may be relevant to improving access to test preparation resources. Examinees from lower SES backgrounds may have trouble affording even low-cost resources. Preparing for the MCAT exam takes considerable time, and examinees from lower SES backgrounds may have other commitments (e.g., work or family obligations) competing for their time compared with examinees from higher SES backgrounds. Portability, ease of use, and access to a reliable internet connection and a mobile device²⁹ may be especially important for examinees of limited means or who are struggling to balance these competing demands on their time.

Examinees also may vary in their awareness of the available test preparation resources and in their access to prehealth advisors. Examinees and prehealth advisors at institutions with fewer resources may be less aware of the AAMC's preparation materials

compared with those at institutions with more resources. Additionally, at schools with formal advising offices, trained prehealth advisors help examinees identify free and low-cost preparatory materials and guide them in how best to use those resources. Less is known about the services and support received by examinees at schools with fewer resources and with part-time (or no) prehealth advisors. Additional research is needed on the association of institutional characteristics like school resources with MCAT exam preparation.

How effectively examinees from different backgrounds employ proven learning strategies in their test preparation is also unexplored to date. Certain learning strategies, such as completing and reviewing practice questions throughout the learning process, can lead to more durable learning than other techniques.^{30–33} The Last Page by Swan Sein and colleagues describes a model for how students can incorporate these learning strategies when preparing for the MCAT exam.³⁴ Also important is studying the association of these various preparation strategies with test performance. Findings from such research may reveal which preparation strategies, alone or in combination, appear most beneficial for students from lower versus higher SES backgrounds or who attend schools with fewer versus more resources.

For the next phase of our work, we plan to collect qualitative and quantitative data from examinees and prehealth advisors to better understand preparation strategies and barriers. Understanding why, how, and when examinees use different preparation strategies may reveal common challenges and allow us to suggest additional resources and outreach that may improve their ability to prepare for the MCAT exam. Qualitative data from interviews with examinees from lower SES backgrounds and who attend institutions with fewer resources will give us a rich sense of the full range of challenges faced by examinees. Interviews with their advisors will provide a different vantage point of those needs. With these data, we can conduct national surveys of examinees to learn about the similarities and differences in preparation for those from different backgrounds and educational experiences.

While our efforts are aimed at issues of access to and preparation for the MCAT exam, far more could be done to expand access to medical school. There is ample evidence that socioeconomic factors affect academic achievement and that those effects emerge early in life and are compounded over time.^{35,36} The solutions to this problem are complex and seem elusive. Lucey and Saguil call for a broader recognition of and attention to the structural inequalities that may impede access to a career in medicine.³⁷ Developing solutions will take partners across the educational pipeline; in fact, many U.S. medical schools are engaged in work that reaches students earlier in their education.³⁸ Although students encounter the MCAT exam later in their academic careers, access to more tailored information and resources to prepare for the exam has the potential to better support a successful pathway to medical school.

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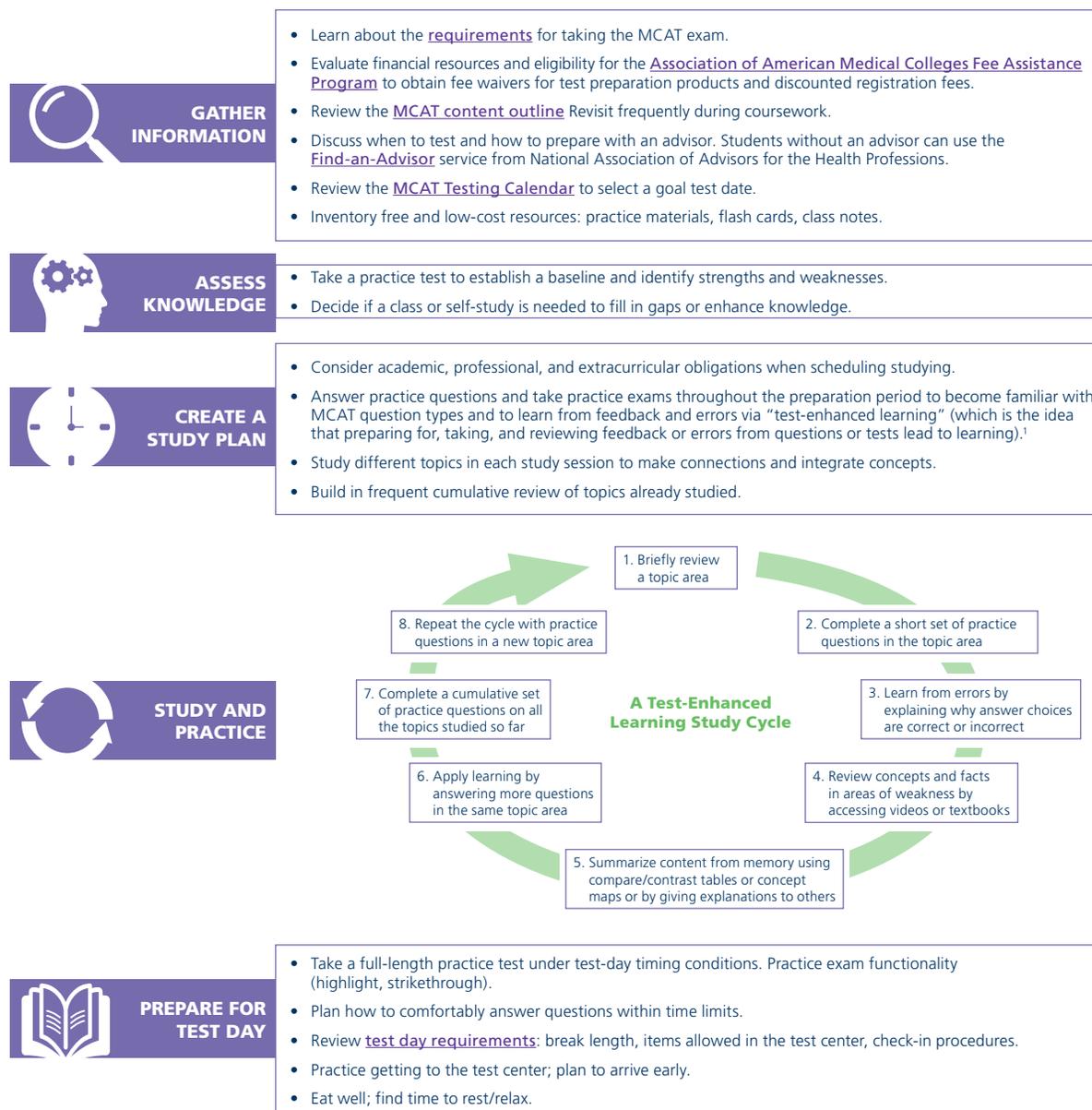
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How to Help Students Strategically Prepare for the MCAT Exam and Learn Foundational Knowledge Needed for Medical School

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The Medical College Admission Test (MCAT) assesses the knowledge and reasoning skills students need to be prepared for medical school. The MCAT exam can also serve as a learning tool that uses authentic problems to help students integrate key concepts. Applying the concepts they are learning in coursework or self-directed study to those covered on the exam not only prepares students for the exam but also helps them build foundational knowledge needed for medical school. Preparing for and taking exams has a demonstrated contribution to learning,¹ and using proven learning strategies² throughout the study period helps develop lifelong study skills and supports learning in medical school. Academic advisors may recommend that students consider the steps below for exam preparation and therefore medical school.



Learn more at www.aamc.org/mcatprep

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The Diversity and Success of Medical School Applicants With Scores in the Middle Third of the MCAT Score Scale

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Abstract

Admissions officers assemble classes of medical students with different backgrounds and experiences who can contribute to their institutions' service, leadership, and research goals. While schools' local interests vary, they share a common goal: meeting the health needs of an increasingly diverse population. Despite the well-known benefits of diversity, the physician workforce does not yet reflect the nation's diversity by socioeconomic status, race/ethnicity, or other background characteristics.

The authors reviewed the Medical College Admission Test (MCAT) scores

and backgrounds of 2017 applicants, accepted applicants, and matriculants to U.S. MD-granting schools to explore avenues for increasing medical school class diversity. They found that schools that accepted more applicants with midrange MCAT scores had more diverse matriculating classes. Many schools admitting the most applicants with scores in the middle of the MCAT score scale were public, community-based, and primary care-focused institutions; those admitting the fewest of these applicants tended to be research-focused institutions and to report pressure to accept applicants

with high MCAT scores to maintain or improve their national rankings.

The authors argue that reexamining the use of MCAT scores in admissions provides an opportunity to diversify the physician workforce. Despite evidence that most students with midrange MCAT scores succeed in medical school, there is a tendency to overlook these applicants in favor of those with higher scores. To improve the health of all, the authors call for admitting more students with midrange MCAT scores and studying the learning environments that enable students with a wide range of MCAT scores to thrive.

Editor's Note: An Invited Commentary by R.M. Schwartzstein appears on pages 333–335.

As medical school admissions officers, we seek broadly qualified applicants who will successfully complete medical school and demonstrate the humanistic qualities that portend well for the practice of medicine. Keeping these 2 objectives in mind, along with the missions and goals of our institutions, we strive to admit applicants who will provide care through a variety of specialties, become researchers and educators, and work to improve our health care delivery system. Our local interests may vary, but they reflect the common goal of meeting the health needs of an increasingly

diverse nation that includes patients who are disadvantaged, live in medically underserved communities, and deserve equitable treatments and cures.

At all levels, medical school leaders believe diversity can help us carry out the work of academic medicine both locally and nationally.^{1,2} For example, an overwhelming number of medical school deans who responded to a recent survey reported that they are or will be pursuing strategies to increase the breadth and depth of diversity in their entering classes.¹ And, almost all of their admissions officers recently reported that selecting students to foster a diverse learning environment or students who have an interest in caring for the underserved was important or very important in identifying applicants who fit with their missions and goals.² We value diversifying our medical school classes in our efforts to develop physicians with cultural humility who will improve health outcomes for all patients.

We in admissions must take this direction and ask, "Are we doing enough to meet the diversity goals of our schools and the nation?" Examining how we use Medical College Admission Test (MCAT) scores as we look for future medical students provides one answer. In admissions, we

use measures of academic achievement, such as grade point averages (GPAs) and MCAT scores, to understand our applicants' academic readiness for the medical school curriculum. Evidence from previous and new versions of the MCAT exam reveals that students with a broad range of scores are capable of progressing through medical school on time, graduating in 4 or 5 years, and passing their licensure exams on the first attempt.^{3–5} Yet many of us limit our choices by only considering applicants with high MCAT scores. In this Perspective, we argue that this practice leads to missed opportunities in light of what we know to be true: Many applicants who obtain midrange scores on the MCAT exam have the qualifications and competencies to do well in medical school and can add tremendously to the diversity of our classes.

Why Is Increasing Diversity So Urgent?

The case for enhancing the diversity of the health care workforce is undeniable. A physician workforce that better reflects the diversity of patients can support efforts to reduce health disparities⁶ and increase access to care for patients who are underserved.⁷ Data show that black and Hispanic physicians are more

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likely to care for patients of similar racial/ethnic backgrounds as well as for patients who lack health insurance, have Medicaid coverage, or live in medically underserved communities.⁸ Research also shows that students from medically underserved or rural backgrounds are more likely to return to similar regions to practice medicine.^{9–11} From the patient perspective, better adherence to recommended health care services and medication, more effective communication, and greater trust are likely to occur when patients see a physician of the same race or ethnicity or who speaks their native language.^{12–15}

Equally important are the benefits that come from diversity in our research workforce. Diverse physician–scientists will pursue a wide range of research inquiries that better address the health needs of the nation and the stark health disparities in underrepresented minority populations.^{16–18} Our workforce will further benefit from an increased number of physicians with diverse perspectives and backgrounds who can take on leadership roles in health care and government.¹⁸ Medical school faculty from minority groups are also more likely to focus on health disparities research than their nonminority colleagues.¹⁹

Diversifying the physician workforce is key to serving patients well. However, the students currently enrolled in medical school woefully underrepresent the populations they will care for based on race/ethnicity, geography, and socioeconomic status.²⁰ Consider that schools in 2017 enrolled 21% of students who were underrepresented based on race/ethnicity, but roughly 30% of the general population is either black/African American, Hispanic, Alaska Native/American Indian, or Native Hawaiian/Pacific Islander.²¹ Schools also enrolled 9% of students who were born or educated in rural communities, but about 20% of the general population lives in rural areas.²² Schools enrolled 16% of students whose parents did not have a bachelor's degree. Yet approximately 70% of the American population is without a 4-year college degree.²³ Bridging the gap between the makeup of society and the backgrounds of our medical students should be a priority for leaders in medical education.

The opportunity to learn in a class composed of students with different perspectives and backgrounds enriches the educational environment for all students and gives them a better appreciation of the issues that contribute to a lack of access to health care.²⁴ Students report that the diversity of their medical school class “[enhanced their] training and skills to work with individuals from different backgrounds.”²⁵ Furthermore, when diverse classes of students learn in supportive environments, the meaningful interactions among students from different backgrounds have the potential to mitigate the negative effects of stereotype threat and improve the mental well-being and educational experiences of underrepresented students during their medical education.^{26,27} Creating a learning environment that enables all students to reach their highest potential is fundamental to producing a diverse physician workforce. Importantly, expanding the diversity of medical student classes will also help prepare future physicians to care for the diverse patient population²⁸ they will encounter as they begin their careers in medicine.

How MCAT Scores Are Used in Holistic Review

Identifying the right combination of students can enable medical schools to effectively carry out their tripartite roles of educating competent and humanistic physicians, caring for patients who come from all parts of the population, and conducting life-saving research that benefits all.

The missions of our respective medical schools may call for us to recruit applicants who are from our state or who grew up in rural communities. Some of us may look for students fluent in other languages to care for patients who do not speak English. We may seek future physician–scientists with the skills and passion for conducting biomedical research. Holistic review helps us accomplish our goals because it provides the foundation for an individualized, and institution-specific, review of applicants. It is adaptable, supported by evidence, and tied to our missions and goals.²⁹

Holistic review helps us in admissions evaluate academic measures, such as GPAs and MCAT scores, in the context of

applicants' life and work experiences, as well as other attributes described in their applications, personal essays, letters of recommendation, and interviews. MCAT scores are one important component in our toolbox, but examining how and why we use them during the admissions process is essential to broadening the pool of qualified applicants for selection.

While we could completely fill our classes with higher-scoring applicants, doing so would prevent us from seeing the depth of each person revealed in the application and those qualities that are not visible from test scores alone. Closely examining the attributes and demonstrated passions of our applicants is at the core of understanding how they will contribute to our schools' missions. Data already show us that, when an admissions committee admits students with scores in the middle of the MCAT score scale who have demonstrated the capacity and competencies needed to become physicians, those students succeed at high rates, progressing through medical school on time,⁵ graduating in 4 or 5 years, and passing their licensure exams on the first attempt.^{3,4} We know that MCAT scores do a good job of assessing applicants' academic readiness for medical school, but success in medical school and beyond draws on more than demonstrated academic readiness.³⁰ The performance of students and the physicians they will become is complex and multidimensional, comprising academic and clinical knowledge and problem-solving skills; interpersonal skills, cultural competence, and the ability to communicate and build relationships; and professional integrity.³¹ The MCAT exam was not designed to and cannot be expected to foretell all the contributions students will make in their communities and to their patients' lives. MCAT scores then must be viewed in the context of the experiences and educational opportunities applicants have had in life.

When the new MCAT exam was launched in 2015 with a new score scale, it gave us in admissions the opportunity to recharge and reevaluate our holistic review processes in a couple of ways. First, we were starting over and needed to develop a new understanding of what MCAT scores told us about applicants' academic readiness for medical school. In the early application cycles, we were reminded of the importance of contextualizing MCAT

scores to identify students who could meet institutional missions and serve our designated populations. Second, the new MCAT score scale was designed to help us better balance scores with the other information we had about applicants, largely by drawing attention to those applicants who scored in the middle of the scale who might help us meet our institutional missions in unique ways. Some of us heeded this advice and took advantage of this time to look at a wider range of scores.³² Largely however our community continues to look at applicants with higher MCAT scores.

We must be vigilant in contextualizing all applicants' MCAT scores during the admissions process. In the following sections, we explain why.

Applicants With Scores in the Middle of the MCAT Score Scale Are More Diverse

Applicants with scores in the middle of the MCAT score scale should

be carefully considered during the admissions process. These individuals have the potential to bring rich sociodemographic diversity to our medical school classes and the physician workforce. Data from 2017 applicants who scored in the middle of the MCAT score scale (495–504) show why these students are so important (see Figure 1).

Figure 1 compares the diversity of applicants who scored in the middle third of the MCAT score scale (495–504) with the diversity of applicants who scored in the upper third of the scale (505–528). (Not shown are applicants with scores in the lower third of the scale [472–494], who typically represent less than 15% of applicants and less than 3% of accepted applicants.) Compared with applicants with scores in the upper third of the score scale, applicants with scores in the middle third were more likely to be the first in their family to obtain a bachelor's degree, have parents in clerical or service positions, or have grown up in rural or medically underserved areas. These

applicants also were more often English-language learning (non-native English speakers) or underrepresented based on race/ethnicity (black/African American, Hispanic, Alaska Native/American Indian, or Native Hawaiian/Pacific Islander). Overall, applicants with scores in the middle third of the MCAT score scale were more diverse than their peers with scores in the upper third of the scale.

Data from the old (in place from 1991 to January 2015) and new (in place from April 2015 to present day) MCAT exams show that medical students with scores in the middle of the score scale perform at similarly high levels as students with scores in the upper third of the scale.^{33,34} For example, graduation data from students who took the old exam showed that 84% of students in the middle third and 89% of students in the upper third of the old score scale graduated from medical school in 4 years. Five-year graduation rates were even higher with 93% of students with scores in the middle third and 96% of students

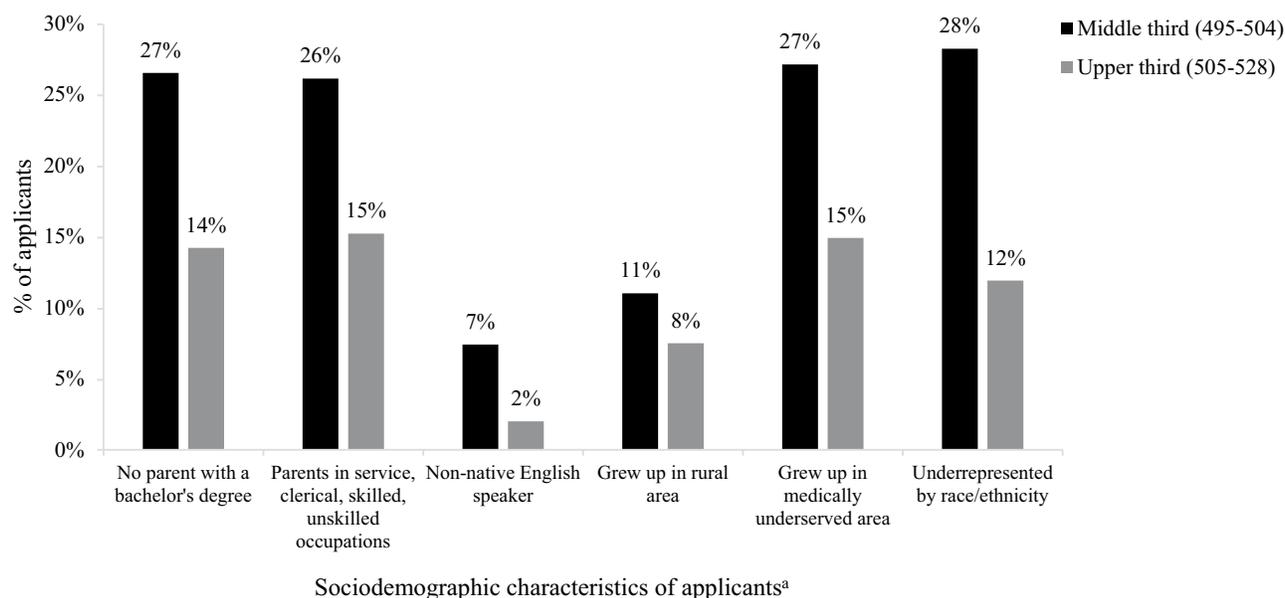


Figure 1 Percentage of 2017 applicants to medical school with Medical College Admission Test (MCAT) scores in the middle or upper third of the new (April 2015–present day) MCAT total score scale, by sociodemographic characteristics. Data are from the 2017 medical school application cycle.²⁰ The primary source of diversity data was the file submitted by the applicant during the 2017 application cycle. The secondary source of diversity data for parental education and occupation, English-language proficiency, and race/ethnicity was MCAT registration data. This secondary data source was only used if data were missing from the applicant file. MCAT total scores were divided into thirds using the distribution of total scores from the 2015 testing year. Percentages are based on unique applicants who answered questions about their locations, backgrounds, and demographics when they applied to medical school. “No parent with a bachelor’s degree” indicates parents’ highest education is less than a bachelor’s degree. “Parents in service, clerical, skilled, unskilled occupation” indicates parents’ highest occupation. “Non-native English speaker” is based on English-language proficiency being self-reported as advanced, good, fair, or basic, rather than native. “Grew up in rural area” is based on either birth county or high school county being classified as rural, as defined by the federal urban–rural classification scheme for counties. “Grew up in medically underserved area” is based on applicants responding affirmatively to a question on their medical school application asking if they grew up in a medically underserved area during childhood. “Underrepresented by race/ethnicity” is based on applicants self-identifying as black or African American, Hispanic, Alaska Native/American Indian, or Native Hawaiian/Pacific Islander. Applicants underrepresented based on race/ethnicity include both those who identified as an underrepresented race alone and in combination with another race. Percentages include U.S. citizens and permanent residents only.

with scores in the upper third of the old score scale graduating in 5 years.³³ While graduation data are not yet available for the new exam, early outcome data for 2016 matriculants showed that those who scored in the middle third of the MCAT score scale completed their first year of medical school and progressed on time to year 2 at similarly high rates as their classmates with scores in the upper third of the scale. That is, 95% of students with scores in the middle third of the score scale progressed on time, compared with 98% of students with scores in the upper third of the scale.³⁴ This is an important milestone because there is a period of adjustment for many students during the first year as they settle into a new curriculum and learning environment, and these data suggest that matriculants with midrange scores are performing well during this time.

Some Schools Accept More Students With Scores in the Middle Third of the MCAT Score Scale Than Other Schools

Figure 1 shows that 2017 applicants with scores in the middle third of the MCAT score scale were more diverse than their peers with higher scores. But what do we know about the schools that accepted them? We rank-ordered schools from those that accepted the largest percentage of applicants with scores in the middle third of the MCAT score scale to those that accepted the smallest percentage of applicants with middle-third scores. We then divided the schools into 4 equal quartiles (see Figure 2).

The first quartile represents those schools with the most accepted applicants with middle-third scores, and the fourth quartile includes those schools with the fewest. The range of accepted applicants with scores in the middle third of the score scale varied widely across schools. For example, in the first quartile, 1 school had 72% of its accepted applicants with middle-third scores, and in the fourth quartile, multiple schools had no accepted applicants with scores in this range.

We then analyzed institutional data and admissions survey data from the schools in each quartile to learn more about their characteristics.^{2,35} Many schools in the first quartile were public institutions,

were community based, and reported that selecting students who intended to practice primary care was an important part of their mission. Schools in the fourth quartile, however, tended to be research focused and to report pressure to accept students with high MCAT scores to maintain or improve their *U.S. News and World Report* rankings. These schools also reported using MCAT scores to identify the most academically capable applicants and that academic metrics were more important than other application data in deciding which applicants to interview.

Admitting Students With Scores in the Middle of the MCAT Score Scale Increases Student Diversity

Our analysis also showed that schools that accepted more students with scores in the middle of the MCAT score scale created more diverse classes across a range of socioeconomic and demographic characteristics that are important to helping schools meet their missions and goals. Table 1 shows the median percentages of 2017 medical school matriculants from diverse backgrounds, by medical school quartile (based on percentage of accepted applicants with scores in the middle third of the MCAT score scale; see Figure 2).

When we compared the schools in the first quartile with those in the fourth quartile, we saw differences in the diversity of their classes. Schools in the first quartile, which accepted larger percentages of students with MCAT scores between 495 and 504, matriculated larger percentages of students who were the first in their family to obtain a college degree, whose parents worked in a “service, clerical, skilled, or unskilled” occupation, who grew up in a rural or medically underserved area, and who were non-native English speakers. Most of these differences are striking.

There is one exception to this trend. The percentages of matriculants who were underrepresented based on race/ethnicity showed the opposite pattern. Schools in the fourth quartile had larger percentages of students who were underrepresented based on race/ethnicity than schools in the first quartile. This finding might be explained by revisiting the characteristics of the schools in the 4 quartiles. Schools in the fourth quartile were more likely to be private and could have had access to resources that enabled them to offer more enticing financial aid packages for students to attend their institutions. On the other hand, the majority of schools in the first quartile

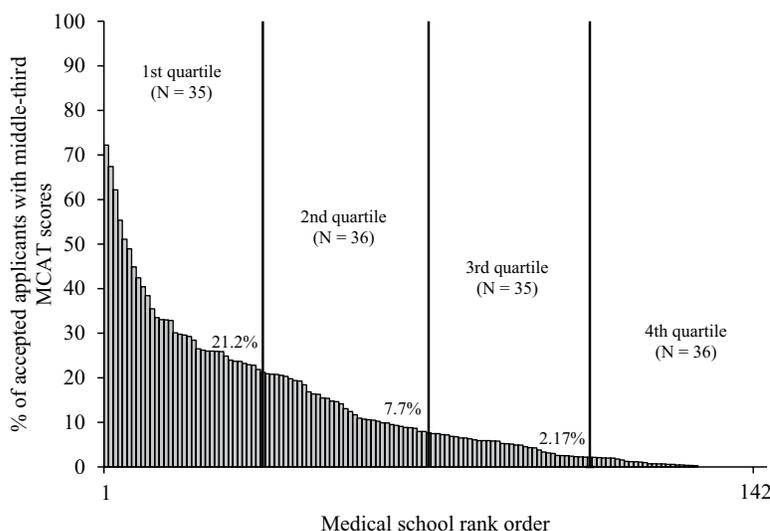


Figure 2 Rank order of medical schools by the percentage of their 2017 accepted applicants with Medical College Admission Test (MCAT) scores in the middle third of the new (April 2015–present day) MCAT total score scale (495–504). Data are from the 2017 medical school application cycle. Only mainland U.S. MD-granting schools were included in the analysis. Schools were rank ordered from the school with the largest percentage of accepted applicants with middle-third scores on the new MCAT exam to the school with the smallest percentage. Middle-third total scores (495–504) were identified using the distribution of total scores from the 2015 testing year. After schools were rank ordered, they were divided into equal fourths. The ranges of the percentage of accepted applicants with middle-third MCAT scores were: 21.2% to 72.2% (first quartile), 7.7% to 20.9% (second quartile), 2.17% to 7.5% (third quartile), and 0% to 2.15% (fourth quartile).

Table 1

Median Percentages of 2017 Medical School Matriculants From Diverse Backgrounds, by Medical School Quartile^{a,b}

Diversity characteristic: Matriculants ...	Median % of matriculants by medical school quartile			
	1st quartile (21.2%–72.2%)	2nd quartile (7.7%–20.9%)	3rd quartile (2.17%–7.5%)	4th quartile (0%–2.15%)
Who have no parents with a bachelor's degree ^c	20	17	15	11
For whom the highest parental occupation is a "service, clerical, skilled, or unskilled" occupation ^d	20	19	15	12
Who are non-native English speakers ^e	4	2	2	1
Who grew up in a rural community ^f	11	8	5	4
Who grew up in a medically underserved area ^g	27	20	15	14
Who are underrepresented in medicine based on race/ethnicity ^h	16	17	18	19
With none of the 6 diversity characteristics above ⁱ	44	52	57	61
With 1 of the 6 diversity characteristics above ^j	26	23	23	22
With 2 or more of the 6 diversity characteristics above ^k	30	25	18	15

^aData are from the 2017 medical school application cycle. The primary source of diversity data was the file submitted by the applicant during the 2017 application cycle. The secondary source of diversity data for parental education and occupation, English-language proficiency, and race/ethnicity was Medical College Admission Test (MCAT) registration data. This secondary source was used only if data were missing from the applicant file. Only mainland U.S. MD-granting schools were included in this analysis.²⁰

^bMedical schools were rank ordered by the percentage of their 2017 accepted applicants who had scores in the middle third of the MCAT score scale, then the schools were divided into quartiles. Scores in the middle third of the score scale (495–504) were identified using the distribution of new MCAT total scores from the 2015 administration cycle.

^cHighest parental education is less than a bachelor's degree. Nationally, 16% of 2017 matriculants had parents without a bachelor's degree.

^dHighest parental occupation is a "service, clerical, skilled, or unskilled" occupation. Nationally, 18% of 2017 matriculants had parents who were in service, clerical, skilled, or unskilled occupations.

^eNon-native English speaker is based on English-language proficiency being self-reported as advanced, good, fair, or basic, rather than native. Nationally, 4% of 2017 matriculants were non-native English speakers.

^fGrew up in a rural area is based on either birth county or high school county being classified as rural, as defined by the federal urban–rural classification scheme for counties. Nationally, 9% of 2017 matriculants grew up in a rural area.

^gGrew up in a medically underserved area is based on the applicant responding affirmatively to a question in their medical school application asking if they grew up in a medically underserved area during childhood. Nationally, 20% of 2017 matriculants grew up in a medically underserved area.

^hUnderrepresented in medicine based on race/ethnicity is based on the applicant self-identifying as black or African American, Hispanic, Alaska Native/American Indian, or Native Hawaiian/Pacific Islander. Applicants underrepresented based on race/ethnicity include both those who identified as an underrepresented race alone and in combination with another race. Percentages include U.S. citizens and permanent residents only. Nationally, 21% of 2017 matriculants were underrepresented based on race/ethnicity.

ⁱThose who met none of the 6 diversity characteristics above. Nationally, 53% of 2017 matriculants met none of the 6 diversity characteristics.

^jThose who met 1 of the 6 diversity characteristics above. Nationally, 24% of 2017 matriculants met 1 of the 6 diversity characteristics.

^kThose who met 2 or more of the 6 diversity characteristics above. Nationally, 24% of 2017 matriculants met 2 or more of the 6 diversity characteristics.

were public and either rural or regional institutions. Additionally, many were from states that had substantially smaller underrepresented populations based on race/ethnicity.³⁶ These factors could have created unique challenges for admissions officers at schools with fewer resources and in certain locations looking to increase diversity based on race/ethnicity.

However, we believe diversity is not a matter of just counting students one characteristic at a time. Diversity, broadly defined, should capture the complexities of a sociodemographically diverse society that is made up of numerous cultures, languages, nationalities, and geographies. Acknowledging and seeking this rich diversity is a sine qua non to meet the needs of our patient population. In the 2017 matriculating class, there were medical students who reflected this mosaic, presenting with different pairs and combinations of backgrounds that

medical schools seek. For example, 21% of matriculants in 2017 identified as underrepresented based on race/ethnicity (see Table 1). More than 10% of these students also reported growing up in a medically underserved area, the most common pairing. Similarly, 16% of matriculants were the first in their family to obtain a college degree. Almost 1 in 5 of these students also reported that their parents' highest occupation was in a service or clerical job.³⁷

Research on the relative importance, interdependence, and number of diversity characteristics of practicing physicians suggests that students with multiple diversity characteristics will be more likely to care for patients who live in medically underserved areas, are medically indigent, or are poor.^{9,38,39} Richer diversity also has value across specialties and in our research, academic, and policy communities.

Table 1 demonstrates the interrelationships and impact of students' diversity characteristics at the schools in each quartile. The data show that, on average, schools in the first quartile matriculated more students with 2 or more diversity characteristics. The median percentage of students at schools in the first quartile who met 2 or more diversity criteria was 30%, compared with a median percentage of 15% for schools in the fourth quartile. These results suggest that schools in the first quartile are constructing classes with richer diversity across more than one dimension than schools in the other quartiles.

Empowering Our Admissions Community to Change

Patients need a physician workforce that reflects the sociodemographic diversity of our country and that has been educated in a learning environment enriched by

the diversity of the class. Because of the pressures medical schools face to admit applicants with high MCAT scores, we run the risk of missing many applicants who are academically qualified and bring additional lived experiences to the learning environment. Change starts with us, and it begins with a reexamination of how and *why* we consider MCAT scores during the admissions process.

With the data we presented in this Perspective, we issue a call to our admissions colleagues to redouble efforts to diversify our medical schools and the profession. We urge all of us in admissions to consider, accept, and support more applicants with scores in the middle third of the MCAT score scale. We should balance the weight given to applicants' MCAT scores with the information in their applications, transcripts, and letters of recommendation to select students with promise and to use all available information to support these students once they matriculate. It is here that we may find greater numbers of potential students who reflect the diversity of the country based on demographics, backgrounds, and perspectives.

This issue of imbalance is global, but the solutions are local. We acknowledge that institutions are doing good work to identify and admit diverse classes of medical students who will contribute to their missions and goals. We encourage every institution to do a little more. What would happen to the diversity of our medical school classes if we all committed to expanding our consideration of applicants with scores in the middle third of the MCAT score scale who have demonstrated the qualifications and competencies to be successful students and physicians? What would it take to admit only a few more students from this group? Our ask is small, but we recognize that some institutions may need to find ways to manage the pressure to admit higher-scoring applicants, such as from national rankings of medical schools. We recommend sharing strategies that would give admissions committees room to be more flexible in their use of MCAT scores. By considering applicants with a wider range of scores in our admissions processes, we likely will find more students from diverse backgrounds who bring new perspectives to our schools.

The evidence that MCAT scores predict academic performance in medical school and on licensing examinations is strong.^{3,4,40} Yet, in every class we admit, we see variability in the academic performance of students with similar MCAT scores.⁴¹ The truth is that we all know of students with more modest MCAT scores who outperformed their classmates with higher MCAT scores. We believe that these students were successful because of the academics, attributes, and experiences they brought and also because of our ability to provide a learning environment in which students from different backgrounds and academic trajectories could thrive. Broadly speaking, this environment includes academic, social, and wellness support in addition to the curriculum, which students can take advantage of or we can require during their education. Some institutions have instilled an inclusive culture of success by carefully creating a curriculum and learning environment that supports all students, including those from diverse backgrounds and experiences.⁴² We must ask ourselves what we can learn from the schools that do this well and how we can create similar learning environments and cultures.

Diversifying the physician workforce is key to serving patients well in our clinics, labs, and the policy arena. As the admissions community, we have an inherent interest in using MCAT scores to admit the applicants our patients need. The data presented in this Perspective provide evidence that drawing more from the middle third of the MCAT score scale has the potential to bring those individuals with impressive and diverse backgrounds into the house of medicine. A conscious and concerted effort is needed to identify these "jewels." We ask all of us in admissions to dedicate ourselves to the work of identifying those applicants with a wider range of MCAT scores who are likely to succeed in medical school and supporting them in ways that promote their academic and professional success.

The need for increased diversity in the physician workforce is pressing, for our communities, our science, our patients, and our future.

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The Consequences of Structural Racism on MCAT Scores and Medical School Admissions: The Past Is Prologue

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Abstract

Those in medical education have a responsibility to prepare a physician workforce that can serve increasingly diverse communities, encourage healthy changes in patients, and advocate for the social changes needed to advance the health of all. The authors of this Perspective discuss many of the likely causes of the observed differences in mean Medical College Admission Test (MCAT) scores between students from groups well represented in medicine and those from groups underrepresented in medicine. The lower mean MCAT scores of underrepresented groups can present challenges to diversifying the physician

workforce if medical schools only admit those applicants with the highest MCAT scores. The authors review the psychometric literature, which showed no evidence of bias in the exam, and note that the differences in mean MCAT scores between racial and ethnic groups are similar to those in other measures of academic achievement and performance on high-stakes tests.

The authors then describe the ways in which structural racism in the United States has contributed to differences in achievement for underrepresented students compared with well-represented

students. These differences are not due to differences in aptitude but to differences in opportunities. The authors describe the widespread consequences of structural racism on economic success, educational opportunity, and bias in the educational environment. They close with 3 recommendations for medical schools that may mitigate the consequences of structural racism while maintaining academic standards and admitting students likely to succeed. Adopting these recommendations may help the medical profession build the diverse physician workforce needed to serve communities today.

Editor's Note: An Invited Commentary by R.M. Schwartzstein appears on pages 333–335.

Medical education is a public good, responsible for preparing the physician workforce that our nation needs and for producing physician–citizens who will participate in and advance our democracy.^{1,2} To accomplish this mission, medical schools must build a physician workforce that is diverse and inclusive with respect to race, ethnicity, and all the rich identities that exist within our communities.³ Racially and ethnically diverse medical students and physicians improve access to care, adherence to treatment, quality of the educational

environment, and breadth and impact of research.^{4–10} Our nation also needs physician–citizens who are prepared to use their voices and the trust our communities place in them to advocate not only for better health care but also for equity in opportunity and in the social systems on which patients rely. Fulfilling these obligations to society requires that all physicians actively recognize and address the pernicious role that structural racism has played in creating and sustaining inequities in health care, education, and societal opportunity in our country.¹¹ A critical first step is to examine the ways in which medical schools use the Medical College Admission Test (MCAT) to evaluate aspiring physicians and the impact these practices have on the profession's ability to build a racially and ethnically diverse physician workforce.

In this Perspective, we look at how MCAT scores are used in admissions and how structural racism and differing access to opportunity create and perpetuate group differences in MCAT scores. We explore how the MCAT exam neither over- nor underpredicts performance among racial and ethnic groups while sharing how assigning too much weight to the highest MCAT scores in admissions decision making makes it difficult to build medical school classes that are representative

of patient communities. Finally, we encourage the medical education and admissions leadership to adopt 3 practices to appropriately use MCAT scores in the context of holistic admissions.

How MCAT Scores Are Currently Used

Extensive validation studies done on each iteration of the MCAT exam demonstrate that it is a psychometrically valid achievement test that predicts applicants' likelihood of success in several aspects of medical education, including medical school coursework, the United States Medical Licensing Examination (USMLE) Step exams, and graduation in 4 or 5 years.^{12–14} The range of MCAT scores that are compatible with success in medical school, however, is wide.^{15,16} Recognizing this, many medical schools use a holistic review approach to evaluate applicants, balancing quantitative assessments of their academic achievements using MCAT scores and undergraduate grade point averages with qualitative data on their premedical school experiences and personal attributes. Still, lower scores on the MCAT exam, even those within the range predictive of success, are associated with lower rates of acceptance to medical school.¹⁶

A persistent affinity for applicants with the highest scores on standardized

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exams is not unique to medical schools. The Supreme Court has heard highly publicized legal cases challenging the appropriateness of admissions decisions that are made using characteristics beyond test scores.^{17–19} Many of these cases question why students with lower scores on standardized exams are admitted to institutions of higher education while students with higher scores are rejected. Implicit in this argument is the assumption that higher test scores are indicative of a better student. The reality is much more nuanced.

In evaluating applicants whose MCAT scores fall within the range of scores that predict success in medical school, admissions committees must consider other important characteristics that suggest that a given applicant will contribute to the workforce that is needed by communities across the country. Focusing on workforce needs, admissions committees may justifiably select applicants with MCAT scores at the lower end of the range predicting success in medical school because, for example, their rural backgrounds increase the likelihood that they will practice in an underserved area, because they speak the language and understand the culture of a major demographic group in the United States, or because their LGBTQ+ identity adds an important perspective to the educational and health care environments. Additionally, while the MCAT exam is designed to measure applicants' academic preparation for medical school, it is not designed to measure or predict their performance related to other, essential competencies, such as interpersonal skills and communication, professionalism, and ethical behavior, or to take the place of other attributes that nonexam aspects of the admissions process evaluate.

Group Differences in MCAT Scores

Individuals of every race and ethnicity obtain scores from the low, middle, and high ranges of the MCAT score scale, but mean scores are lower for applicants from racial and ethnic groups underrepresented in medicine (URM) compared with mean scores for their peers who are from groups well represented in medicine. These group differences on the new MCAT

exam are similar to those on the old exam^{20,21}; on other measures of academic achievement; and on high-stakes exams, such as the SAT, ACT, GRE, GMAT, and LSAT.^{22,23} Overlooking applicants with anything but the highest scores contributes to persistent challenges in diversifying medical school classes. This practice is particularly problematic when the weight accorded to MCAT scores in admissions decision making is greater than the weight given to other predictors of students' success, such as demonstrated community service, clinical and research experiences, and personal competencies.^{24,25}

Seeking a quick solution, some have called for eliminating the MCAT exam or reporting scores as pass or fail.^{26–28} Eliminating the exam would prevent medical schools from using the scores to ensure that applicants have demonstrated sufficient achievement to be ready for medical school. A pass–fail scoring system would hinder the work of schools that employ holistic review admissions processes to admit applicants with a wide range of MCAT scores, including scores that would fall below a national pass–fail cutoff.¹⁶ Instead, leaders in medical education must work to understand the root causes of group differences in MCAT scores and propose, pilot, and disseminate appropriate countermeasures.

Why Group Differences Exist

The recognition that mean MCAT scores differ between white, black, and Latinx populations has led many to view the exam as intrinsically biased.²⁷ However, psychometric studies show that this is not the case. Psychometric validity exists when a high-stakes exam neither over- nor underpredicts the subsequent performance of different examinee populations. Scores from the old MCAT exam did not show bias against black and Latinx medical students in predicting their success in medical school and on licensing exams (i.e., the success rates of students from these races/ethnicities were not higher than their scores predicted).²⁰ Early research on the new exam shows that new scores predict success in the first year of medical school comparably for examinees from URM and non-URM backgrounds.¹⁴

In this Perspective, we provide a closer look at these group differences, which reveal that while the MCAT exam predicts medical school performance in the same way for students from different backgrounds, the educational opportunities afforded to students from kindergarten to the time they take the MCAT exam are not equitable. Unequal opportunities in housing, education, and other areas of society for different populations have led to differing levels of academic achievement, reflected in mean score differences on high-stakes examinations and in other measures of academic success between URM and non-URM students with similar aptitudes. These unequal opportunities and the resulting differences in achievement have their roots in structural racism.

Structural Racism and Unequal Opportunity

Centuries of structural and interpersonal racism and bias have contributed to racial and ethnic disparities in wealth, health, and educational opportunity. While overt discrimination against people of color was outlawed in the 1960s, hundreds of years of legalized discrimination before that time created the conditions in which minority populations remain significantly disadvantaged, even today.²⁹ When first introduced, government programs, such as Social Security,^{30,31} the Federal Housing Administration loan program,³² and the GI Bill, implicitly or explicitly prevented minority populations from receiving benefits,^{33,34} causing them to endure substantial, sustained economic disadvantage.^{11,35,36} These and other programs also promoted residential segregation and prevented home ownership among people of color, concentrating minority populations in low-income neighborhoods with inadequate access to quality housing, economic/occupational opportunity, health care, fresh food, quality schools, and public safety.^{11,35} In addition, the criminal justice system continues to produce disparate outcomes for people of color, contributing to family fragmentation, poverty, and diminished employment opportunities for previously incarcerated individuals.³⁷

These and other discriminatory practices have negatively affected economic success in minority populations. In 2016, the

median level of wealth for white families was \$171,000, while the median wealth for black families was \$17,600. Data from 2015 show that 3 times as many children of color as white children live in households below the poverty level.^{38,39}

The negative impact of these social systems and practices on educational opportunity is striking. Because the major source of local government funding for public schools comes from property taxes, housing inequality leads to educational inequality.⁴⁰ Supplemental Digital Appendix 1 available at <http://links.lww.com/ACADMED/A734> includes 2 illustrations of the persistent impact of 20th-century discriminatory housing policies on 21st-century educational opportunity.^{41,42} Panel A shows a 1935 map of redlined communities in San Francisco, California, that were deemed hazardous for mortgage lending because of their high concentration of black residents.⁴¹ Panel B shows a map of low-quality schools today concentrated in the same geographic areas as the redlined communities in 1935.⁴²

Across the nation, black and Latinx children are more likely than white children to live in poverty, experience food insecurity, reside in single-parent households, and grow up in families where no parent has full-time, year-round employment.²⁰ Minority children also are more likely to attend low-quality day care and show elevated blood lead levels.²⁰ Black and Latinx students are more likely to attend schools with high teacher turnover, inexperienced teachers, and teachers who are not certified in the subjects they teach.^{20,43} In addition, unstable parental employment may require children to change schools more frequently.²⁰ Black and Latinx students are more likely than Asian or white students to attend a high-poverty school⁴⁴ and to report the presence of gangs in school.⁴⁵ High schools in low-income areas are much less likely to offer advanced placement coursework or skilled college advisors.^{46,47}

These unequal educational opportunities continue into college. Lack of family wealth may lead minority students to begin their college education in the community college system⁴⁸ and to work during school, leaving them with less time for studying, unpaid internships,

shadowing, and other experiences. Minority students from lower-resourced colleges and universities may have less access to the necessary prerequisites for medical school, academically beneficial experiences such as research projects, or experienced and accessible health professions career advisors.^{49,50}

While economics are important, a high socioeconomic status does not protect students of color from the negative effects of structural and interpersonal racism.⁵¹ Studies have documented that even at low-poverty schools, discipline in K–12 education is more frequent and severe for children of color than for white children,^{52,53} leading to interrupted or terminated school experiences. Opportunities to participate in gifted and talented programs are more often denied to minority students in school systems that do not employ sound selection procedures, a finding that persists across socioeconomic levels.⁵⁴ Even minority students from middle or high socioeconomic levels can experience the negative effects of low expectations, denying them the encouragement and support to pursue educational opportunities beyond high school.^{55,56}

These and many other examples of structural and interpersonal racism underpin the observed group differences between URM and non-URM students in academic achievement and in scores on high-stakes exams. As we have explained, social, economic, employment, health, and criminal justice challenges all negatively affect students' achievement. Not all URM students experience all of these trials, but most experience at least some of them. Despite multiple barriers to success, many aspiring medical students from URM groups demonstrate substantial achievement, earning MCAT scores that are within the range that predicts success in medical school.¹⁶ Equitable interpretation of MCAT scores requires consideration of the context in which each applicant earned those scores, rather than assuming that all applicants had equal opportunities.

What Can Be Done?

Addressing this opportunity gap is daunting for medical educators, but it is not impossible. Leaders in medical education can address the impact of

unequal opportunity on the diversity of the nation's physician workforce using 3 critical levers: admissions processes, pipeline programs, and curriculum.

Admissions processes: Use MCAT scores wisely

Medical school leaders must instruct and support their admissions committees to understand and use MCAT scores appropriately, eschewing the use of such scores for anything other than identifying the achievement level that students need to succeed in their institutions. The MCAT exam enables every medical school to identify applicants whose current level of achievement may be too low to succeed in their school. Beyond that cutoff, selecting students based on small differences in scores is not supported by the data on the reliability of the exam.¹⁶ Despite this psychometric evidence, admissions officers describe pressure from institutional stakeholders to select students with the highest scores because the ranking of the medical school depends in part on the mean MCAT score of the matriculating class.⁵⁷

Medical schools that have assembled classes of capable, diverse students use several strategies. First, they identify the full range of MCAT scores associated with success at their school. Then, they consider each applicant's score in context, recognizing that a history of multiple adverse educational experiences related to race or ethnicity may lead to scores that are lower than those of other applicants but still predictive of success.⁵⁸ Furthermore, these schools build a learning environment in which the obstacles to achievement that may have existed for their students before entry into medical school are highly attenuated or eliminated.

The University of California, San Francisco, School of Medicine, for example, published data documenting that the gap in standardized exam scores between URM and non-URM students narrows at each stage of medical school, suggesting that a supportive learning environment may help URM students achieve success at a faster rate than their non-URM peers.⁵⁹ Morehouse School of Medicine also reported achievement in fostering the success of students who entered the school with a wide range of MCAT scores.⁶⁰ The success of holistic

review in diversifying medical school classes has led residency programs to adopt a similar approach to selecting interns, recognizing that excess weighting of scores on the standardized, high-stakes USMLE Step exams interferes with the goal of diversifying residency programs.^{61,62}

Achieving greater diversity through admissions requires making changes to the whole admissions process. Medical schools are exploring multiple strategies for achieving this aim, for example, employing anonymous voting systems; blinding interviewers to academic metrics; and using multiple mini-interviews and scoring rubrics to give equal weight to experiences, attributes, and academic metrics. In addition, ensuring diversity in the composition of admissions committees and encouraging admissions committee members to complete training in mitigating unconscious bias can help them make judgments about academic and professional promise given each applicant's unique context.^{25,63}

Pipeline programs: Enhance opportunities for applicants to prepare for medical school

Medical schools and national medical education organizations must redouble their efforts to address the proximate barriers to success for URM students aspiring to become physicians. Success on the MCAT exam requires exam-specific preparation in addition to high-quality higher education. The Association of American Medical Colleges (AAMC) has worked to decrease barriers to test preparation by providing free study guides and tools and reduced-price registration for applicants with financial hardship.⁶⁴ Additionally, the AAMC has collaborated with the Khan Academy and the Robert Wood Johnson Foundation to provide a collection of free, online, video-based tutorials on the topics covered on the MCAT exam.⁶⁵ Unfortunately, use of these test preparation resources is lower among premedical students from lower socioeconomic backgrounds and those who attend lower-resourced schools.²¹

These students also may not have ready access to knowledgeable individuals who can advise them on best practices to prepare for the MCAT exam. Health professions advisors play an important role

in preparing undergraduate students to be strong, academically qualified medical school applicants; however, such advisors are not equitably distributed across the nation's higher education institutions. Underresourced institutions are less likely to provide institutional or financial support for premedical advising.⁶⁶ Recognizing the value of high-quality health professions advisors, the National Association of Advisors for the Health Professions offers advising services free of charge to students from colleges that do not have dedicated health professions advisors.⁶⁷

Many medical schools have developed partnerships with communities and schools across the educational continuum to support URM and socioeconomically disadvantaged students interested in health professions careers. The success of these endeavors depends on a broad-based institutional commitment to diversity that is sustained with financial support and based in respectful community engagement. For example, the University of Illinois at Chicago Urban Health Program includes initiatives that span elementary school through undergraduate education and provides access to and preparation for all health professions; it is aimed at the needs of URM students, many of whom attend underresourced schools.⁶⁸ Medical schools also sponsor programs that enable prehealth advisors from nearby undergraduate institutions to learn more about the medical school admissions process and MCAT exam preparation.⁶⁹⁻⁷¹ Other schools embrace their role as an anchor institution, leveraging their system's procurement, investment, and employment opportunities to improve the educational and economic milieu for those in the surrounding community, including those aspiring to health professions careers.⁷²

Curriculum: Educate physician-citizens

As a profession and as individuals, physicians are trusted for their ability to think critically and advise individuals and communities about threats to health. No greater threat to health exists today than the disparities in our social systems, which shorten lives, obstruct access to evidence-based health care, impoverish families, incarcerate generations, and attenuate educational achievement. The next generation of physicians can take on this work if we are able to build

a diverse workforce through holistic admissions and help them to develop the expertise they need. All medical schools must train the next generation of physicians to understand the existence and extensive ramifications of structural racism and the resultant health and health care disparities. Additionally, recognizing how structural racism leads to interpersonal bias may help physicians address their own personal biases that contribute to health care inequities.⁷³ Diversifying medical school classes is a critical first step in educating physicians to work effectively with individuals from all populations. Schools also must establish core competencies related to understanding structural racism and its influence on health and health care disparities. In addition, structural competence and antiracism curricula should be introduced in undergraduate and graduate medical education.⁷⁴⁻⁷⁶

Conclusions

Structural racism is the result of centuries of discrimination against people of color in the United States. Its roots are deep and its consequences far-reaching. Medical education and the profession of medicine are as affected by this stain as other social systems are. The medical profession can successfully educate the diverse physician workforce that our communities need and prepare all physicians to be the citizens our democracy needs if we collectively commit to understanding and counteracting the impact of structural racism on medical student selection and education and on the provision of health care. Embracing new ideas about what MCAT scores are desirable may be more acceptable if the purpose behind this necessary mindset change is to mitigate the effects of society's structural racism.

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Leveraging the Medical School Admissions Process to Foster a Smart, Humanistic, and Diverse Physician Workforce

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Abstract

An excellent physician has a range of talents, including the knowledge and critical thinking abilities to work with the rapidly changing biomedical and social science content of the profession as well as the interpersonal and communication skills to build meaningful relationships with patients and families. The Medical College Admission Test (MCAT) was revised in 2015 to focus more on analytical reasoning skills and behavioral and social sciences knowledge to ensure that future physicians have the capabilities needed to care for patients in the 21st century and to allow admissions committees to identify applicants

who have demonstrated proficiency in these areas. With these changes, scores continue to be predictive of student performance in the preclerkship curriculum.

In this Invited Commentary, the author argues that, as educators struggle to define the characteristics of the “right” candidates for medical school and design processes to identify and admit those applicants, it is important to consider the message being sent by calls for the MCAT exam to play a reduced role in admissions decisions. Educators must avoid diminishing the

importance of intellectual rigor and, while pursuing goals for a more diverse physician workforce, maintain standards that ensure medicine’s commitment to patients. The author concludes with suggestions for how educators can work with under-resourced colleges and premedical programs to help disadvantaged students get the preparation they need to succeed in medical school and throughout their careers. Taking these steps will allow educators to support students, prepare them for practice, and fulfill their obligation to the public to produce excellent physicians.

Editor’s Note: This is an Invited Commentary on Lucey CR, Saguil A. The consequences of structural racism on MCAT scores and medical school admissions: The past is prologue. Acad Med. 2020;95:351–356; Terregino CA, Saguil A, Price-Johnson T, Anachebe NF, Goodell K. The diversity and success of medical school applicants with scores in the middle third of the MCAT score scale. Acad Med. 2020;95:344–350; Girotti JA, Chanatry JA, Clinchot DM, et al. Investigating group differences in examinees’ preparation for and performance on the new MCAT exam. Acad Med. 2020;95:365–374; and Busche K, Elks ML, Hanson JT, et al. The validity of scores from the new MCAT exam in predicting student performance: Results from a multisite study. Acad Med. 2020;95:387–395.

Performance on the Medical College Admission Test (MCAT) is a significant factor in the decision to admit an applicant to medical school; thus, the validity and

use of the new MCAT exam is intertwined with questions about who should and will be the doctors of tomorrow, particularly as arguments grow about the importance of a diverse physician workforce for the health of our population. To answer these questions, the medical education community has focused largely on the medical school admissions process to identify the “right” students.

In this issue, Busche and colleagues offer evidence that the new MCAT exam remains a valid predictor of performance in the preclerkship curriculum and that it is not systematically biased against any racial or socioeconomic groups.¹ Students who do well on the new MCAT exam are as well or better prepared for a career as a physician as those who took the previous version of the exam, and they are likely to reason better and can apply knowledge of important concepts in the social and behavioral sciences. However, whether due to less access to preparation materials² or inequalities in their premedical education,³ students from lower socioeconomic groups do not perform as well on the new MCAT exam, which has led some to advocate that performance on the MCAT exam is given too much weight in the admissions process.^{3,4}

As educators struggle to define the characteristics of the “right” candidates for medical school and design processes to identify and admit those applicants, we should consider the message we may be sending inadvertently by calling for the MCAT exam to play a reduced role in admissions decisions.

The Role of the MCAT Exam in Admissions

Several years ago, I had the good fortune to serve on the 5th Comprehensive Review of the MCAT Review Committee (MR5 Committee), convened by the Association of American Medical Colleges (AAMC) to help guide the development of the new MCAT exam. The committee was a large group that included faculty and premedical advisors from colleges and medical schools across the United States. Both public and private institutions were represented. Over the course of the 3 years that the committee met, our discussions were wide ranging, earnest, and reflective of the competing priorities of the members.⁵ We wanted future doctors with intellectual rigor, strong critical thinking skills, good communication skills, and who were humanists.

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The committee recommended that the MCAT exam be changed to emphasize critical thinking skills (e.g., the ability to analyze and interpret data) rather than factual recall. In addition, a section on the behavioral and social sciences was added to signal that being an excellent doctor requires more than knowledge of the biological and chemical sciences. In retrospect, I think we spent less time than we should have on other important traits like curiosity and resilience (or “grit”), as curiosity about the patient as a person and about the pathophysiology of her problem is one way to bridge differences between patients and doctors and to minimize cognitive bias and error.⁶ Becoming and being an excellent doctor is challenging intellectually, emotionally, and physically; if passion and perseverance are the essence of grit,⁷ we surely need those traits in our doctors. Of course, there are limits to what one can learn from a standardized exam score, yet holistic admissions processes are designed in large part to help us discern the presence of these characteristics in applicants.

Nevertheless, the MCAT exam is the starting point. Scores are predictive of students’ performance in the first phase of medical school and of their ability to learn, digest, and apply the scientific principles needed for the practice of medicine. However, the premedical curricula available at colleges likely affects how applicants perform on the MCAT exam, so individuals from lower socioeconomic groups and those attending under-resourced colleges may well be disadvantaged when they take the MCAT exam. Because some medical schools place a high value on MCAT scores, the exam has been perceived to be a barrier to achieving greater diversity in the physician workforce.^{3,4} How then do we determine what role the MCAT exam should play in the admissions process?

Some members of the MR5 Committee advocated that the new MCAT exam be pass/fail. Others pointed out that further distinctions among students are needed since there are more students applying than there are slots available at medical schools. If admissions committees cannot assess applicants’ academic performance using their MCAT scores, they will default to using other measures, such as grade point average and the rigor of the applicant’s undergraduate institution,

potentially disadvantaging students from lesser known, under-resourced colleges. With the assistance of researchers at the AAMC, the MR5 Committee modeled the impact of changing the MCAT exam to pass/fail. This analysis demonstrated that many students from lower socioeconomic groups who were admitted to medical school in the present system of reporting actual MCAT scores would have been excluded in a pass/fail system. Consistent with this observation, Terregino and colleagues found that schools that accepted more applicants with midrange MCAT scores had more diverse matriculating classes.⁴ These findings suggest that the holistic admissions process works.

Graduation rates for these students remain high. But when only 2% of students fail to complete medical school for academic reasons,⁸ we must also be sure that we have not lowered our expectations and standards during medical school while arguing for less emphasis on MCAT performance when making admissions decisions.

Is Competence Enough?

Over the last 2 decades, the idea of admitting applicants who are merely “smart enough” for medicine has emerged. Competency-based medical education (CBME) is designed to ensure that students do not advance through medical school unless they are competent; however, “competent” generally has been defined as the bare minimum required for acceptability. While the original notion of CBME was that students would remain in place until they achieved competence (or were counseled to pursue another profession if they failed to improve after remediation), today much greater attention is devoted to shortening training by moving students along as soon as they achieve competence.⁹ Less attention is given to the fact that competence is context specific and that experience (i.e., seeing many patients under varying conditions) is an important element in the development of meaningful competence.

The implications of having fewer medical school experiences, if students move through the curriculum more quickly, are compounded by the changing environment at the residency level. As a medical intern, I evaluated more than

400 patients whom I admitted to the hospital. In contrast, a typical intern today personally admits fewer than 100 patients. The failure of educators to consider the importance of experience for their learners has led to concerns about the true competence and autonomy of residency graduates.^{10,11}

Entrustable professional activities (EPAs) theoretically would set the bar higher than “competence,” but a recent review of the literature revealed that the data do not yet support the use of this approach as an assessment tool.¹² The inter-rater reliability for determining entrustability is fair at best.¹³ Frame of reference training,¹⁴ which requires a major investment in time and resources for a medical school with many faculty, may be necessary to truly attain validity in EPA decisions. Furthermore, few faculty members are willing to commit to stating that a student cannot proceed to the next phase of the curriculum because of EPA ratings.

From my experience and what I have heard from colleagues around the country, it is difficult to slow down, if not stop, a student’s progression through medical school because of academic performance issues. A former chair of the Harvard Medical School promotions and review board observed that faculty view their students like their patients, that is, they never abandon them, and multiple students over the years have described their medical school experience not as “pass/fail” but as “pass/pass.” Failure is not truly a grading option for most faculty, and students seem to know this. There are invariably mitigating reasons for the poor performance, claims that educators will address the deficits in the next phase of the curriculum, or concerns about how the student will perceive the setback. Too often I have heard that deficiencies will be addressed by the student’s residency program.

While much has been written about “productive failure,” we as educators have become intensely protective of our students.¹⁵ We do not allow them to fail. Additionally, if we move a student along for several years before concluding that a career in medicine is not right for that person, we are reluctant to remove her from school because she may be saddled with significant debt and no degree.

As educators, we are in a unique position. We have a responsibility to our students to support and prepare them for practice, but we also have a responsibility to the public to produce excellent doctors. We know that MCAT scores predict performance in the early years of medical school.¹ We should not discount their role in identifying who those excellent doctors may be.

An Alternative Solution

About 15 years ago, as discussions about the role of MCAT scores in the admissions process became more acute, I remember hearing what I thought was a perplexing argument at national meetings. Prominent educational leaders seemed to create a false dichotomy: We can have “smart” doctors or “compassionate, humanistic” doctors. I think there is a third option: We can and should have doctors who are both.

With that goal in mind, there is probably no magic formula for picking the “right” medical students. In fact, there are many types of “right” students, given the range of clinicians, researchers, and educators we need. Yet even in meeting these needs, we cannot make major compromises. For example, the doctor with a great academic record and research potential may care for patients one day, so she must also have the requisite interpersonal and communication skills to graduate. Similarly, the doctor who is a great communicator also needs the cognitive acumen to think critically and avoid the pitfalls of pattern recognition and diagnostic error. During our multifaceted admissions process, I believe that it is acceptable to take a risk on a promising applicant who may not rank as highly as someone else in one or another of the attributes needed to be an excellent doctor, but we must also commit to truly maintaining high standards for our students and to working hard to improve students’ areas of weakness during medical school. If remediation is not successful, however, we must redirect students to other career paths.

Ideally, we should not need to take risks in the admissions process. As a society, we are more likely to fix problems after they arise than to invest in their prevention. For example, we know

that the social determinants of health lead to untold misery, yet we invest in treatments for the resulting diseases rather than address the root causes of the problem. The MCAT exam is an accurate assessment of an applicant’s preparation in the foundational principles of the biological, chemical, and social sciences needed for the study of medicine. If as a community our efforts to foster a more diverse physician workforce are being thwarted by socioeconomic factors that impair the ability of talented students to compete effectively, we should address the true cause of the problem (e.g., inadequate preparation in high school and college to handle the intellectual challenges of medicine), rather than create a workaround once those students reach medical school.

Potential solutions include reaching out to under-resourced colleges and universities with predominantly underserved student populations to work with those students who entered college unprepared for the rigorous premedical curricula or with those who do not have access to such curricula. We also could use new educational technology, such as the HMX online courses,¹⁶ to supplement the premedical curricula at these under-resourced colleges. We could develop more postbaccalaureate programs designed specifically for disadvantaged students to help them enter medical school with the necessary academic foundation to succeed. Finally, we can encourage our own universities to invest faculty time and resources in the development and implementation of these kinds of programs so that all students have the opportunity to master the premedical curricula and demonstrate their talents on the MCAT exam and beyond in medical school. Together, we can create a physician workforce that is made up of smart, humanistic, and diverse doctors, without making compromises during the medical school admissions process.

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