AAMC

Medical College Admission Test®

Using MCAT® Data in 2020 Medical Student Selection

MCAT® is a program of the Association of American Medical Colleges

www.aamc.org/mcat

Using MCAT® Data in 2020 Medical Student Selection

Association of American Medical Colleges
Washington, D.C.

This is a publication of the Association of American Medical Colleges (AAMC). The AAMC serves and leads the academic medicine community to improve the health of all. aamc.org.

Contents

My advice to you in 2020 student selection

This guide offers recommendations for using MCAT® scores in conjunction with all the information provided by each medical school applicant. It also describes how medical schools work with MCAT scores in the context of holistic review.

Applicants provide admissions committees with rich information about their experiences, attributes, and academic backgrounds through their applications, personal statements, and interviews. Letter writers also provide information about applicants' academic and personal competencies. Your institutional mission, goals, and priorities provide a framework for using this rich and varied information in holistic ways to evaluate applicants and admit a class of capable, caring students who bring diverse interests, talents, and experiences to your institution.

Holistic review practices provide the foundation for selecting applicants with the academic and personal competencies that future physicians need. It is important to remember the following recommendations for considering data about academic preparation in the context of all the information collected during the admissions process.

- Carefully consider the rich and assorted data that applicants provide. Weigh these data about applicants' experiences, attributes, and academic preparation in ways that help you meet your institution's goals.
- Triangulate score information from the MCAT exam with information about applicants' course completion, grades, grade trends, institutions attended, research experience, and other academic indicators. You should look for consistencies and inconsistencies in the stories these data tell.
- For MCAT scores in particular, consider the precision with which total and section scores measure applicants' academic preparation. When making decisions about whom to interview and accept, remember: Scores that are close together are not meaningfully different.
- Scores from the MCAT exam should not outweigh other application data in deciding which applicants will get secondary application invitations, interview invitations, or acceptance offers.

Considering these recommendations and the data presented in this guide will help your admissions committee construct a class that meets the academic, clinical, service, and research missions of your medical school.

Finally, a new collection of articles that offers additional insights into using MCAT scores in admissions will appear in *Academic Medicine* in summer 2019. The articles describe findings about how well MCAT scores predict students' performance in the first year of medical school, how examinees prepare for and perform on the exam, how admissions committees can admit more diverse classes by considering applicants with a wider range of MCAT scores, and how to help students strategically prepare for the exam. Visit academicmedicine.org to read these articles and future publications summarizing findings from research in progress.

Please don't hesitate to reach out to MCAT staff at mcatvalidity@aamc.org with questions.

Sincerely,

Geoffrey H. Young, PhD
Senior Director, Student Affairs and Programs
AAMC

Introduction

This guide provides current information and data about the MCAT exam to help admissions officers and their committees make informed decisions about applicants' academic readiness for medical school. It describes the concepts and skills measured by the exam. It shows the characteristics of examinees who took the MCAT exam from 2016 to 2018 and how these examinees prepared for and performed on the exam. It also presents guidance on how to read the MCAT score report and interpret differences in scores and shows data about how admissions committees worked with MCAT scores and undergraduate grade point averages (GPAs) in the 2017 and 2018 admissions cycles.

This guide provides the most recent findings about the value of MCAT scores and undergraduate GPAs in predicting students' performance in medical school. New validity findings include data on how well MCAT scores and undergraduate GPAs predict students' performance across preclerkship courses and on the United States Medical Licensing Examination (USMLE) Step 1 exam (first attempt), and their progression through the first two years of medical school.

The information in this guide will support schools' holistic review of applicants, which encompasses all of the information gathered during the admissions process. Putting MCAT scores in the context of applicants' experiences, attributes, and other academic data enables admissions officers and their committees to select the students who will contribute to their institutions' unique missions, goals, and diversity interests. Using MCAT scores in the context of these assorted sources of information is a cornerstone of holistic review and a tenet of sound score use advocated by educational testing standards.[1]

What does the MCAT exam measure?

The MCAT exam is designed to help admissions committees select students who are academically prepared for medical school. MCAT scores are among many sources of application data that admissions committees use in student selection. The scores help admissions officers interpret grades and other academic data coming from undergraduate institutions that have different curricular emphases and grading standards.

The MCAT exam tests the foundational concepts and reasoning skills needed to be ready for today's medical school.

The MCAT exam has four 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
4. Critical Analysis and Reasoning Skills

Shown in Figure 1, the two natural sciences sections and the behavioral and social sciences section of the MCAT exam test 10 foundational concepts and four scientific inquiry and reasoning skills that are the building blocks for learning in medical school. These sections ask test takers to combine their knowledge of concepts from courses in first-semester biochemistry, psychology, and sociology and year-long courses in biology, chemistry, and physics with their scientific inquiry and reasoning skills to solve problems presented in passages and test questions. The resulting scores provide information about applicants' readiness to learn in medical school.

The Critical Analysis and Reasoning Skills 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. The passages are drawn from the humanities and social sciences. All the information test takers need to respond to the questions in this section appears in the passages or in the questions themselves (see Figure 1). Appendix A provides more detailed descriptions of the concepts and reasoning skills tested by each of the four sections of the exam.

Figure 1. Foundational concepts and scientific inquiry and reasoning skills tested on the MCAT exam.

Biological and Biochemical Foundations of Living Systems	
Foundational Concept 1	Biomolecules have unique properties that determine how they contribute to the structure and function of cells and how they participate in the processes necessary to sustain life.
Foundational Concept 2	Highly organized assemblies of molecules, cells, and organs interact to carry out the functions of living organisms.
Foundational Concept 3	Complex systems of tissues and organs sense the internal and external environments of multicellular organisms and, through integrated functioning, maintain a stable internal environment within an ever-changing external environment.
Chemical and Physical Foundations of Biological Systems	
Foundational Concept 4	Complex living organisms transport materials, sense their environment, process signals, and respond to changes using processes that can be understood in terms of physical principles.
Foundational Concept 5	The principles that govern chemical interactions and reactions form the basis for a broader understanding of the molecular dynamics of living systems.
Psychological, Social, and Biological Foundations of Behavior	
Foundational Concept 6	Biological, psychological, and sociocultural factors influence the ways that individuals perceive, think about, and react to the world.
Foundational Concept 7	Biological, psychological, and sociocultural factors influence behavior and behavior change.
Foundational Concept 8	Psychological, sociocultural, and biological factors influence the way we think about ourselves and others.
Foundational Concept 9	Cultural and social differences influence well-being.
Foundational Concept 10	Social stratification and access to resources influence well-being.

Scientific Inquiry and Reasoning Skills

MCAT questions on these three sections ask test takers to solve problems using the following scientific inquiry and reasoning skills.

Knowledge of Scientific Concepts and Principles
- Demonstrating understanding of scientific concepts and principles.
- Identifying the relationships between closely related concepts.

Scientific Reasoning and Problem Solving
- Reasoning about scientific principles, theories, and models.
- Analyzing and evaluating scientific explanations and predictions.

Reasoning About the Design and Execution of Research
- Demonstrating understanding of important components of scientific research.
- Reasoning about ethical issues in research.

Data-Based and Statistical Reasoning
- Interpreting patterns in data presented in tables, figures, and graphs.
- Reasoning about data and drawing conclusions from them.

Critical Analysis and Reasoning Skills	
Examinees demonstrate their information processing skills in three areas.	
Foundations of Comprehension	• Understanding basic components of the text, such as the main idea and conclusions. • Inferring meaning from rhetorical devices, word choice, and text structure.
Reasoning Within the Text	• Integrating different components of the text to increase comprehension or analysis.
Reasoning Beyond the Text	• Applying or extrapolating ideas from the passage to new contexts, situations, possibilities, alternatives, options, or proposals. • Assessing the impact of introducing new factors, information, or conditions to ideas from the passage.

How is the MCAT exam scored?

The section and total score scales are centered on memorable numbers that draw attention to the center of the scales. Scores on the four sections of the exam are reported on numeric scales centered at 125 and ranging from 118 to 132. Scores from the four sections are summed to produce a total score centered at 500 and ranging from 472 to 528.

The MCAT score scales draw attention to the center of the scales to encourage admissions committees to consider applicants with a wide range of scores.

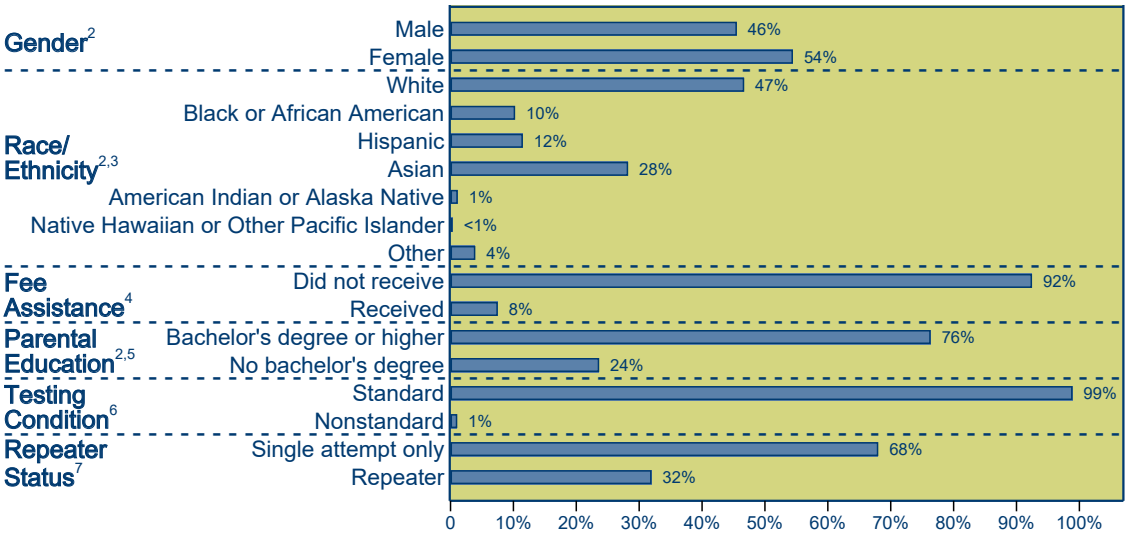
Research on the current version of the MCAT exam, introduced in 2015, suggests that the students who enter medical school with scores at the center of the scale succeed. Findings presented on pages 30 and 31 of this guide show that 2016 entrants with a wide range of MCAT scores progressed through their first two years of medical school on time and passed the Step 1 exam on the first attempt. If history is a guide, these and future entrants will graduate within four or five years and pass their licensing exams on the first try, just like students admitted with a wide range of scores from the previous exam did.[2]

Who takes the MCAT exam?

Examinees with a wide range of backgrounds and experiences took the exam from 2016 to 2018. Figure 2 shows the percentages of the 206,297 examinees by gender, race/ethnicity, and other background characteristics and experiences.

More than half of examinees were female. When describing their race/ethnicity, almost half of examinees identified as white, 10% as black or African American, 12% as Hispanic, and 28% as Asian. About 8% were awardees of the AAMC's Fee Assistance Program, 24% reported that none of their parents received a bachelor's degree, and 1% tested with a nonstandard testing condition. Finally, 32% of the examinees who tested from 2016 to 2018 took this version of the MCAT exam more than once since it was introduced in 2015.

Figure 2. Percentages of MCAT examinees from 2016 to 2018, by gender, race/ethnicity, fee assistance status, parental education, testing condition, and repeater status.[1]



Notes:

1. The total number of examinees who took the MCAT exam from 2016 to 2018 was 206,297. For those who took the exam more than once, their information from the most recent administration was used in these analyses.
2. Percentages describe examinees who provided information about their gender, race/ethnicity, and parental education.
3. Percentages add up to more than 100% because racial/ethnic minority results include examinees who may have designated more than one race/ethnicity.
4. The AAMC's Fee Assistance Program eligibility is limited to examinees who are U.S. citizens or U.S. permanent residents or students with Deferred Action for Childhood Arrivals (DACA) status.
5. Examinees report the highest level of education for up to four parents. From 2016 to 2018, 198,683 examinees provided information about parental education. These results are for the highest level of parental education.
6. Score reports do not indicate whether scores were obtained under standard or nonstandard testing conditions.
7. For repeater status, "Single attempt only" includes examinees who took the current MCAT exam for the first time in 2016, 2017, or 2018 and did not test again. "Repeater" includes examinees who tested from 2016 to 2018 and who took this version of the MCAT exam more than once in their testing history. Some repeaters tested only once from 2016 to 2018, but they are included among repeaters because they took the exam in 2016, 2017, or 2018 and also in a previous year not included in this analysis.

How do examinees prepare for the MCAT exam?

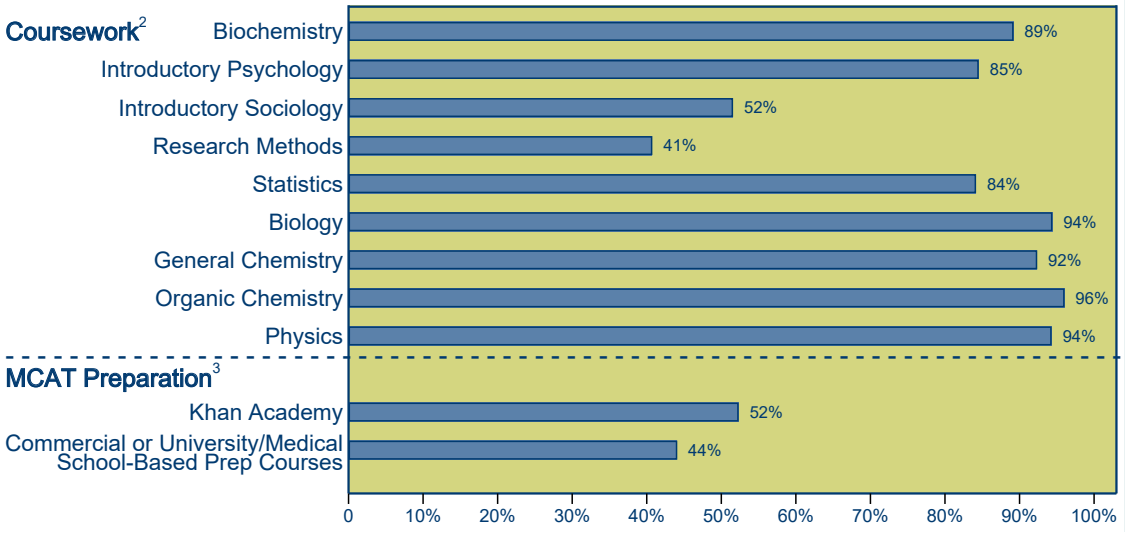
As described previously, the MCAT exam tests concepts from first-semester biochemistry, psychology, and sociology courses and year-long courses in biology, chemistry, and physics. It asks examinees to demonstrate that they can reason about research and data to answer questions about those concepts.

Data about the courses completed before taking the exam show preparation in these areas (refer to Figure 3). The coursework data in Figure 3 come from examinees who responded to the AAMC's 2018 Post-MCAT Questionnaire (PMQ).[3] Almost all took biology, chemistry, and physics courses. Most also took courses in biochemistry, psychology, and statistics before testing; many took courses in sociology and research methods.

Examinees also studied for the MCAT exam in a variety of ways. Fifty-two percent reported using the Khan Academy MCAT collection, which includes free, online video lessons and test questions covering concepts and reasoning skills tested on the MCAT exam. Forty-four percent took either a commercial preparation course or a course based at a university or medical school before sitting for the exam.

Many PMQ respondents also reported reading on their own, taking online courses, or volunteering or working in research labs or other settings that provided exposure to topics tested on the MCAT exam. (The 2018 *Post-MCAT Questionnaire Summary Report* is available at aamc.org/data/pmq.)

Figure 3. Percentages of MCAT examinees from 2016 to 2018 who completed college coursework in the natural, behavioral, and social sciences or who prepared for the MCAT exam by using the Khan Academy or completing a test preparation course.[1]



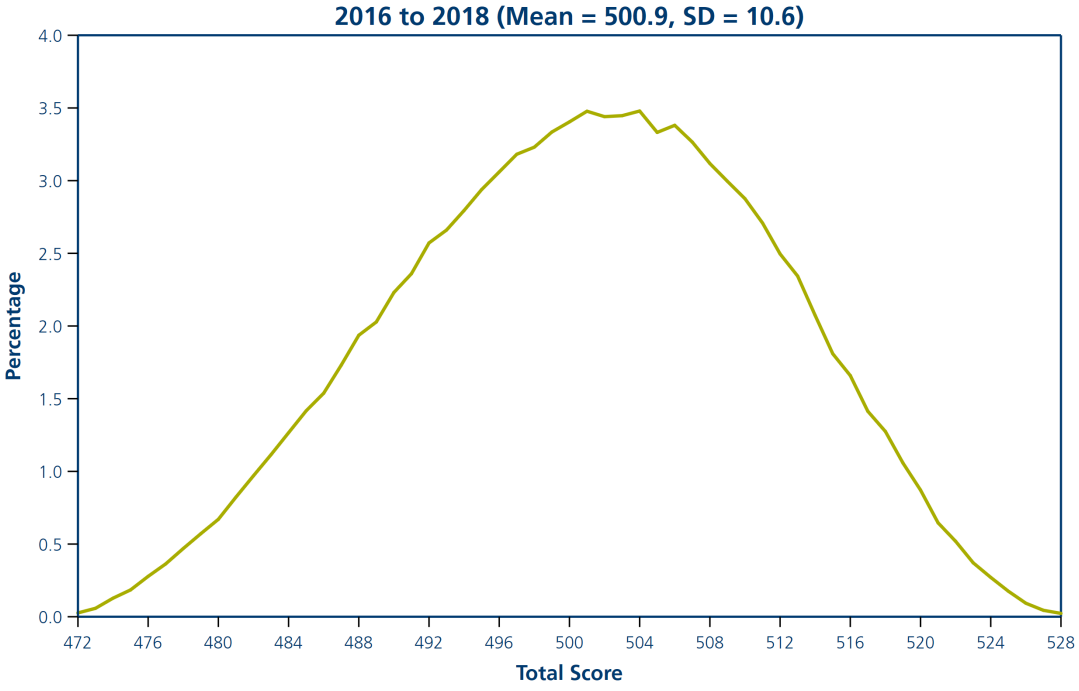
Notes:

1. The total number of MCAT examinees from 2016 to 2018 was 206,297.
2. Percentages were calculated from the data supplied by respondents to the Post-MCAT Questionnaire (PMQ) who provided information about their coursework. Respondents self-reported the courses for which they had Advanced Placement (AP), International Baccalaureate (IB), College Level Examination Program (CLEP), community college, four-year college, postbaccalaureate, graduate, and professional school credit. Each year, approximately 35% of examinees complete the PMQ. They are similar to the examinee population on most background characteristics but obtain slightly higher average MCAT scores. From 2016 to 2018, 63,834 examinees completed the PMQ. For those who completed the PMQ more than once, results are based on their most recent responses. The data are from only those PMQ respondents with valid scores.
3. Percentages were calculated from examinee responses to questions about their MCAT preparation asked at the end of the testing day. The number of examinees from 2016 to 2018 who provided this information was 200,374. For those who tested more than once, results are based on examinees' most recent responses.

How well do examinees score on the MCAT exam?

Figure 4 summarizes the MCAT total and section scores from all exams administered in 2016, 2017, and 2018. For the examinees who tested more than once from 2016 to 2018, all their scores are included. The mean MCAT total score was 500.9, and the standard deviation was 10.6. Means and standard deviations for the section scores also appear in Figure 4.

Figure 4. Summary of MCAT total and section scores for exams administered from 2016 to 2018.



Section Score Summary for Exams Administered from 2016 to 2018 (N = 268,493)	Mean	(SD)
Chemical and Physical Foundations of Biological Systems	125.1	(3.0)
Critical Analysis and Reasoning Skills	124.8	(2.9)
Biological and Biochemical Foundations of Living Systems	125.4	(3.0)
Psychological, Social, and Biological Foundations of Behavior	125.6	(3.1)

Note:
The total number of exams administered from 2016 to 2018 was 268,493. These results include multiple scores for the examinees who took the MCAT more than once from 2016 to 2018.

Figure 5 gives additional detail about students' total scores in 2016, 2017, and 2018. It summarizes the MCAT scores both overall and for examinees from different backgrounds and experiences, including gender and race/ethnicity, status in the AAMC's Fee Assistance Program, and highest level of parental education. It also shows scores from examinees who tested under standard and nonstandard testing conditions and first- and second-attempt scores for examinees who took the exam more than once.

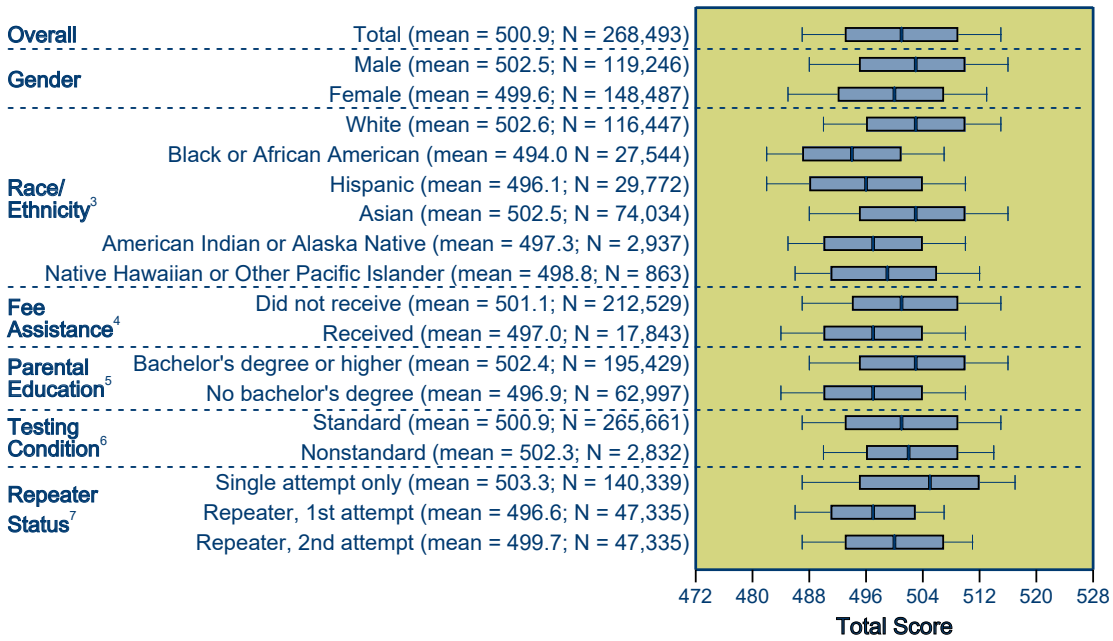
Figure 5 uses box-and-whisker plots to show the median score (the 50th-percentile score), along with the 10th-, 25th-, 75th-, and 90th-percentile scores. The 10th- and 90th-percentile scores are shown by the ends of the "whiskers," the 25th- and 75th-percentile scores are shown by the "box" (the left edge of each box shows the 25th-percentile score, and the right edge shows the 75th-percentile score), and the median is

shown by the vertical bar inside each box. For example, for female examinees, the 10th-, 25th-, median-, 75th-, and 90th-percentile scores were 485, 492, 500, 507, and 513, respectively. The mean MCAT total score for each group appears in parentheses by the group label.

For every group, there are examinees with scores near the bottom, at the middle, and near the top of the MCAT total score scale.

There is variability in the median MCAT total scores for examinees from different backgrounds. However, there is a great deal of overlap in the scores of different groups. The similarities and differences in these data are similar to those reported in the literature for other admissions tests.[4,5] Research suggests that the differences in MCAT scores for examinees from groups underrepresented in medicine based on race/ethnicity and other background characteristics reflect societal inequalities in income, education, and other factors rather than test bias.[6]

Figure 5. MCAT total scores for exams administered from 2016 to 2018, overall and by gender, race/ethnicity, fee assistance status, parental education, testing condition, and repeater status.[1,2]



Notes:

1. The total number of exams administered from 2016 to 2018 was 268,493.
2. These results include multiple scores from the examinees who tested more than once from 2016 to 2018.
3. Data for examinees who reported their race/ethnicity as "other" are not shown.
4. The AAMC's Fee Assistance Program eligibility is limited to examinees who are U.S. citizens or U.S. permanent residents or students with Deferred Action for Childhood Arrivals (DACA) status.
5. Examinees report the highest level of education for up to four parents. These results are for the highest level of parental education for examinees who took the MCAT exam from 2016 to 2018.
6. Score reports do not indicate whether scores were obtained under standard or nonstandard testing conditions.
7. For repeater status, "Single attempt only" includes the scores from the examinees who took the current MCAT exam for the first time in 2016, 2017, or 2018 and did not test again. "Repeater" data include scores from the examinees who took the MCAT exam for the first time in 2016, 2017, or 2018 and then tested at least one more time during this window. They are a subset of those who tested more than once since this version of the MCAT exam was introduced. The "1st attempt" plot shows these repeaters' scores from their very first attempt, and the "2nd attempt" plot shows these same examinees' scores from their second attempt.

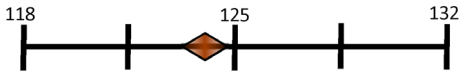
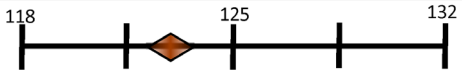
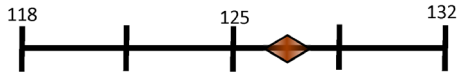
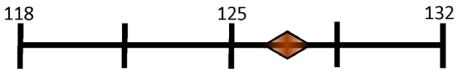
How precise are examinees' MCAT scores, and how should they be interpreted?

Four types of information are essential for interpreting MCAT scores:

- Total and section scores.
- Confidence bands.
- Percentile ranks associated with the scores.
- Score profile.

Figure 6 shows an example of an examinee's score report that includes these four components. Details about the confidence bands, percentile ranks, and the score profile are included below. Other resources — including an interactive version of the score report; videos describing the concepts and reasoning skills tested by the new exam; and downloadable fact sheets describing the scores, confidence bands, percentile ranks, and score profile — can be found at aamc.org/mcatscorereport.

Figure 6. Example score report.

Section	Score	Confidence Band[1]	Percentile Rank of Score[2]	Score Profile[3]
Chemical and Physical Foundations of Biological Systems	124	123–125	43%	
Critical Analysis and Reasoning Skills	123	122–124	35%	
Biological and Biochemical Foundations of Living Systems	127	126–128	74%	
Psychological, Social, and Biological Foundations of Behavior	127	126–128	70%	
MCAT Total	501	499–503	51%	

Notes

[1] Test scores, like other measurements, are not perfectly precise. The confidence bands around test scores mark the ranges in which the test taker's true scores probably lie. The diamond shapes and shading show the test taker's true scores are more likely to be their reported scores (in the second column) than the other scores in the confidence bands.

[2] The percentile ranks of scores are the percentages of test takers who received the same scores or lower scores. The percentile ranks are updated on May 1 every year to reflect the results from the three most recent previous calendar years.

[3] For the four sections, non-overlapping confidence bands show a test taker's likely strengths and weaknesses. Overlapping confidence bands suggest that there are not meaningful differences in performance between sections.

Confidence bands

Like other measurements, MCAT scores are imperfect measures of examinees' true levels of preparation. They are not perfectly precise. Examinees' scores can be dampened by factors such as fatigue, test anxiety, and less-than-optimal test room conditions, or they can be boosted by recent exposure to some of the tested topics.

Confidence bands remind admissions committee members not to overemphasize small differences in scores.

Confidence bands describe the precision of MCAT total and section scores. They show the ranges in which an examinee's true scores probably lie. Reviewing applicants' scores with the confidence bands in mind prevents overinterpretation of small differences in test scores.

MCAT total scores are reported with a 68% confidence band of plus or minus two points, and MCAT section scores are reported with 68% confidence bands of plus or minus one point. Adding and subtracting two points to an MCAT total score of 500, for example, defines a confidence band that begins at 498 and goes to 502. This means that in 68% of cases, the true score for an examinee with a reported score of 500 lies within the band that goes from 498 to 502.

Figures 7 and 8 illustrate how confidence bands can be used to interpret MCAT total scores. The reported score for each examinee is shown as a square. The 68% confidence band around each examinee's score is shown by the dashed lines in the figure.

Figure 7 shows that examinee A scored 500, and examinee B scored 502. The 68% confidence bands around these scores overlap. The overlap between the two confidence bands suggests that the two reported scores may not be meaningfully different from each other.

Figure 8 shows that examinee A scored 500, and examinee C scored 506. The confidence bands around their scores do not overlap, suggesting that the two scores are more likely to be meaningfully different from each other (compared with the scores for examinees A and B).

Figure 7. Confidence bands for two examinees with similar reported scores.

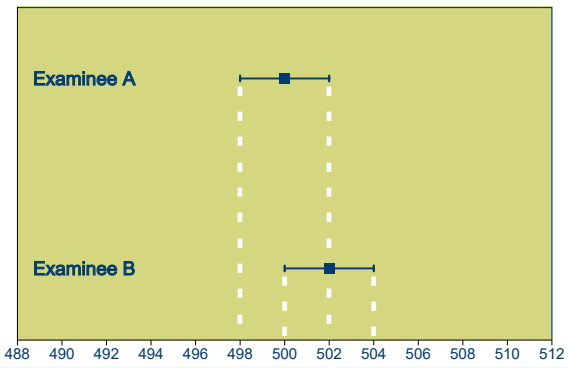
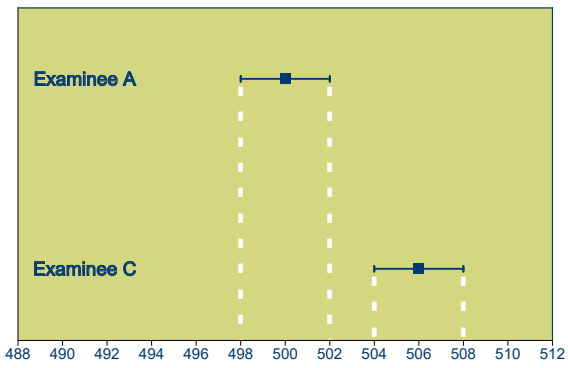


Figure 8. Confidence bands for two examinees with dissimilar reported scores.



Percentile ranks

The percentile ranks for the total and section scores show how the scores of individual applicants compare with the scores of others who took the exam. The percentile ranks show the percentages of test takers who received the same or lower scores on the exam.

For example, the MCAT total score in Figure 6 is 501. It has a percentile rank of 51%. This means that 51% of MCAT scores were equal to or less than 501.

Every year on May 1, the percentile ranks for MCAT scores are updated using data from the previous three administration years. This is a common practice in the standardized test industry and ensures that percentile ranks reflect current information about examinees' scores. Because examinees change from one year to the next, the percentile ranks associated with scale scores may change over time. Basing the percentiles on data from three administration years instead of one year makes the results more stable, but it doesn't prevent year-to-year changes.

That is why MCAT scores have more meaning than percentile ranks. The methods that MCAT developers use to write test questions and build and equate test forms keep the meaning of scores constant over test forms and time. The exam is not graded on a curve. No matter when applicants tested, whom they tested with, or what test forms they took, their scores have common interpretations. MCAT scores describe applicants' academic readiness in relation to the body of knowledge and skills that medical school faculty have described as prerequisite for entering medical students.

The current percentile ranks are based on data from 2016, 2017, and 2018. Appendix B shows the MCAT total and section score percentile ranks that will be in effect from May 1, 2019, to April 30, 2020.

Score profiles

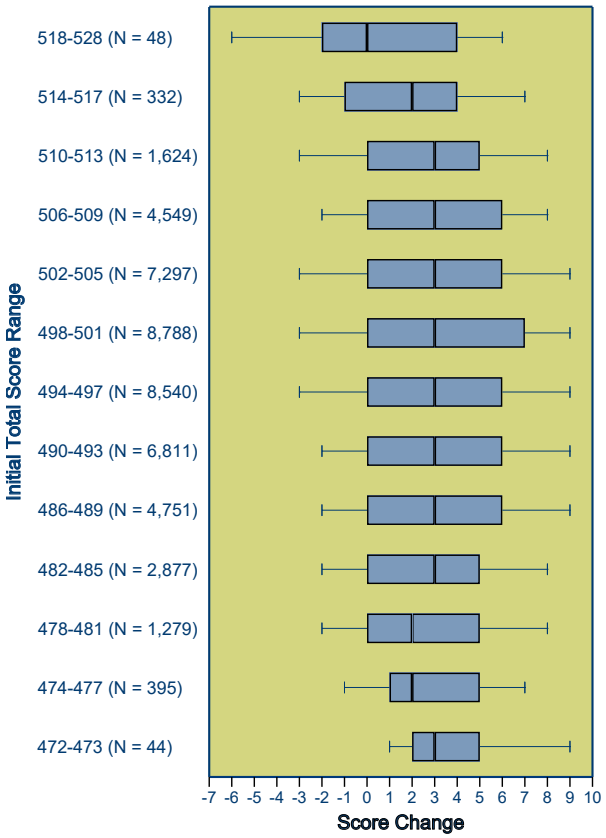
Score profiles highlight applicants' strengths and weaknesses across the four sections of the exam through reported scores for each section. Figure 6 illustrates the score profile associated with an applicant's MCAT section scores. Applicants' strengths and weaknesses on the exam can be considered along with other information about their academic preparation (e.g., coursework and grades) and in relation to institutional missions and goals.

How do examinees' scores change when they retake the MCAT exam, and how do admissions officers use scores for applicants who test more than once?

MCAT examinees can test up to three times in one calendar year and four times across two calendar years. An examinee cannot take the exam more than seven times in their lifetime. Analyses of MCAT total scores from test takers' first and second attempts show the types of score gains obtained upon retesting. Figure 9 uses box-and-whisker plots (described earlier for Figure 5) to show the distributions of score gains (and losses) on examinees' second attempts at the exam, by their first-attempt scores. These analyses include scores from test takers who tested for the first time in 2016, 2017, or 2018 and then retook the exam in that window.

The data show that retesters across a wide range of scores tend to obtain higher scores on their second exams. Figure 9 shows that the median gain was two to three score points for examinees who tested a second time and whose first-attempt scores ranged from 472 to 517. For examinees whose initial scores ranged from 518 to 528, it was zero points. It is important to note, however, that there was considerable variation in the magnitude and direction of score changes, with some examinees posting increases or decreases greater than four points.

Figure 9. Changes in MCAT total scores between the first and second attempts for MCAT examinees from 2016 to 2018 who retested.



Note:
These box-and-whisker plots show changes in MCAT total scores from the first to the second attempt for examinees (N = 47,335) who took this version of the MCAT exam for the first time during this three-year period and then tested a second time in this same window.

A recent survey asked admissions officers how they work with retesters' MCAT total scores in the admissions process.[11] The results showed that admissions officers use different strategies for examining retesters' scores. For example, some admissions committees use all exam scores in conjunction with other information about academic preparation that may explain any score changes. Other admissions committees use applicants' most recent exam scores in the admissions process or applicants' "best score" as represented by their highest reported total score. Other committees compute the average total score across the multiple attempts.

It is important for admissions officers to examine the information in applicants' transcripts and applications in interpreting retesters' scores. Data not shown in Figure 9 suggest that average score gains on the second attempt are greater when the time between the first and second attempt is greater. Information in applicants' files, such as completion of a postbaccalaureate program or other coursework, can help explain gains in applicants' scores over time.

How do admissions officers use MCAT scores and other application data in the holistic review of applicants' qualifications?

As already mentioned, MCAT scores are among many sources of application data that admissions committees use to select medical students. The scores help admissions officers interpret grades and other academic data that come from undergraduate institutions with different curricular emphases and grading standards. In addition to applicants' academic data, admissions officers examine applicants' experiences and demographic and personal attributes. Applicants provide a great deal of data about their academic and life experiences, demographics, and personal characteristics through their applications, personal statements, and interviews. Letter writers also provide rich information about applicants' academic, experiential, and personal attributes.

The procedures that admissions officers from different medical schools use to review these data on applicants' qualifications differ in ways that reflect the schools' unique missions, goals, and curricula, as well as the sizes and characteristics of their applicant pools. To learn more about the holistic review of applicants' qualifications, the AAMC periodically surveys admissions officers about the importance of different academic, experiential, demographic, and personal attribute data in making admissions decisions.[7-11]

Reviewing more information about the experiences and attributes of applicants helps admissions committees put academic metrics in better balance.

Table 1 summarizes the results of a 2015 AAMC survey of admissions officers. The table highlights the importance of different types of data in admissions decision-making. The results of this and previous AAMC surveys on the use and importance of data for making admissions decisions show that experiences, academic metrics, demographics, and attributes all weigh heavily in decisions to offer interview invitations and acceptances.[9,12]

More recently, admissions officers were surveyed about the relative weight they give to undergraduate GPAs and MCAT scores compared with other information in applicants' files to learn how they place these metrics in context at different stages of the admissions process.[11]

The data show that the importance of undergraduate GPAs and MCAT scores, relative to other criteria, decreases as more information about applicants is gathered. Admissions officers are better able to balance data about academic metrics when they are placed in the context of applicants' experiences and attributes. For example, 80% of admissions officers rated other criteria just as or more important in making acceptance offers, compared with 60% who rated other criteria just as or more important in inviting applicants to interview. Placing applicants' MCAT scores in the context of their lived experiences, academic trajectories, and personal attributes during the admissions process enables medical schools to meet their missions and goals and not overlook students who would make valuable contributions to their programs.

Table 1. Mean Importance Ratings of Academic, Experiential, Demographic, and Interview Data Used by Admissions Committees for Making Decisions About Which Applicants Receive Interview Invitations and Acceptance Offers[1]

Mean Importance Ratings[2]	Academic Metrics	Experiences	Demographics	Other Data
Highest Importance Ratings (≥3.0)	• GPA: cumulative biology, chemistry, physics, and math • MCAT total score • GPA: grade trend • GPA: cumulative total • GPA: cumulative total from postbaccalaureate premedical program • MCAT total score trend • Completion of premedical course	• Community service/volunteer: medical/clinical • Community service/volunteer: not medical/clinical • Physician shadowing/clinical observation • Leadership	• U.S. citizenship/permanent residency (Public)[3] • State residency (Public)[3] • Rural/urban, underserved background	• Interview results[4]
Medium Importance Ratings (≥2.5 and <3.0)	• Completion of challenging upper-level science courses • GPA: cumulative "all other" (not biology, chemistry, physics, and math)	• Paid employment: medical/clinical • Research/lab • Other extracurricular activities • Military service	• Race/ethnicity • U.S. citizenship/permanent residency (Private)[3] • Parental education/occupation/ socioeconomic status (SES)	
Lowest Importance Ratings (<2.5)	• Degree from graduate or professional program • Completion of challenging nonscience courses • Selectivity of undergraduate institution(s) • Undergraduate major	• Teaching/tutoring/ teaching assistant • Paid employment: not medical/clinical • Intercollegiate athletics • Honors, awards, recognitions • Conferences attended, presentations, posters, publications	• First-generation immigrant status • Fluency in multiple languages • Gender • English language learners • State residency (Private)[3] • Legacy status • Community college attendance • Age	

1. Admissions officers at 130 medical schools completed a 2015 AAMC survey on the use and importance of data in admissions decision-making. The survey asked, "How important were the following data about academic preparation, experiences, attributes/personal competencies, biographic/demographic characteristics, and interview results in identifying the applicants to [interview, offer an acceptance]?"
2. Importance was rated on a scale ranging from 1 to 4 ("Not Important," "Somewhat Important," "Important," and "Very Important," respectively). For each variable, we computed an overall mean importance rating based on admissions officers' ratings of importance for making decisions about whom to interview and whom to accept (the mean importance rating for the interview variable is the exception to this rule because interview data were not available until applicants were invited to interview). We chose to classify variables using overall mean importance ratings because their mean importance ratings were similar for the interview and the acceptance phases. Variables are ordered by overall mean importance rating.
3. Overall mean importance ratings for public and private institutions were significantly different from one another.
4. Only available at the admissions stage where admissions committees make a decision to offer an acceptance.

National-level data on the academic credentials of applicants whom admissions committees accept reinforce the messages the survey data provide. Table 2 shows the percentages of applicants with different undergraduate GPAs and MCAT total scores who were accepted into one or more medical schools in 2017 or 2018. These data show that although undergraduate GPAs and MCAT scores are important factors in admissions, they are not the sole determinants of admissions decisions.

Each year, some applicants with high MCAT scores and undergraduate GPAs are rejected by all the medical schools to which they applied. In contrast, other applicants with more modest MCAT scores and undergraduate GPAs are accepted by at least one medical school. For example, in 2017 and 2018 student selection, 11% of applicants with GPAs of 3.8 or above and MCAT total scores of 518 or above were rejected by all of the medical schools to which they applied. In contrast, about 13% of applicants with GPAs of 3.0 to 3.19 and MCAT total scores ranging from 498 to 501 were accepted by at least one medical school.

Table 2. Percentage and Number of 2017 and 2018 Applicants Accepted Into at Least One Medical School, by MCAT Total Score and Undergraduate GPA Range

	MCAT Total										
GPA Total	**472-485**	**486-489**	**490-493**	**494-497**	**498-501**	**502-505**	**506-509**	**510-513**	**514-517**	**518-528**	**All**
3.80-4.00	3% 3/107	3% 7/217	8% 40/482	19% 204/1,061	31% 668/2,141	51% 1,782/3,500	64% 3,207/5,009	76% 4,156/5,492	83% 3,971/4,772	89% 4,213/4,743	66% 18,251/27,524
3.60-3.79	0% 0/250	1% 6/416	5% 40/884	13% 221/1,692	25% 707/2,869	36% 1,520/4,177	51% 2,538/4,929	66% 3,014/4,549	75% 2,209/2,944	83% 1,478/1,774	48% 11,733/24,484
3.40-3.59	1% 5/382	1% 7/577	4% 41/1,108	10% 190/1,865	19% 510/2,691	28% 939/3,366	38% 1,359/3,554	52% 1,475/2,835	63% 979/1,559	71% 565/791	32% 6,070/18,728
3.20-3.39	<1% 1/455	<1% 2/559	3% 26/1,001	8% 118/1,483	16% 290/1,864	22% 471/2,138	30% 584/1,919	40% 556/1,383	50% 347/695	58% 158/273	22% 2,553/11,770
3.00-3.19	<1% 1/499	1% 5/515	2% 13/710	6% 62/959	13% 136/1,070	22% 223/1,034	26% 237/908	35% 228/650	42% 103/245	46% 57/123	16% 1,065/6,713
2.80-2.99	1% 3/459	1% 2/367	2% 9/439	5% 23/481	7% 37/504	16% 75/462	21% 76/361	25% 48/190	28% 31/110	39% 14/36	9% 318/3,409
2.60-2.79	0% 0/306	1% 2/212	<1% 1/278	4% 10/254	9% 22/257	18% 31/175	14% 17/124	16% 11/69	43% 18/42	--	7% 117/1,726
2.40-2.59	0% 0/229	1% 1/120	2% 2/122	4% 5/124	3% 3/87	17% 11/63	26% 10/39	27% 8/30	30% 3/10	--	5% 45/830
2.20-2.39	0% 0/126	0% 0/67	0% 0/55	3% 1/37	12% 4/34	23% 6/26	10% 2/21	14% 2/14	--	--	5% 19/387
2.00-2.19	0% 0/76	0% 0/22	5% 1/20	0% 0/18	--	9% 1/11	--	--			1% 2/159
less than 2.00	0% 0/38	--	10% 1/10	--		--		--			1% 1/67
All	<1% 13/2,927	1% 32/3,081	3% 174/5,109	10% 834/7,981	21% 2,377/11,522	34% 5,059/14,953	48% 8,030/16,868	62% 9,498/15,217	74% 7,663/10,381	84% 6,494/7,758	42% 40,174/95,797

Notes:

1. Dark green shading = acceptance rates ≥ 75%; light green shading = acceptance rates of 50-74%; gray shading = acceptance rates of 25-49%.
2. Dashes = cells with fewer than 10 observations; blank cells = cells with 0 observations.
3. For students who took the MCAT exam multiple times, the most recent MCAT total score was used in this analysis.
4. Table summarizes data for 2017 and 2018 applicants who reported MCAT scores from the current exam and undergraduate GPAs (N = 95,797). About 92% of 2017 and 2018 applicants applied with scores from the current version of the MCAT exam.

How well do undergraduate GPAs and MCAT scores predict students' performance in medical school?

This section describes how well undergraduate GPAs and MCAT scores predict medical student performance. It presents findings for students who entered medical school in 2016 with scores from the current exam. These are the first students admitted with scores from this version of the MCAT exam, introduced in 2015. Most of these students are now in their clerkships, and this section of the guide shows how well MCAT scores predict their performance across preclerkship courses and on the Step 1 exam. Subsequent editions of this guide will present findings related to clerkship performance, performance on the Step 2-CK and Step 2-CS exams, and graduation within four or five years for this and future cohorts.

The relationships among undergraduate GPAs, MCAT scores, and medical student performance are presented in the pages that follow. The first segment presents the associations of undergraduate GPAs and MCAT scores with performance on two continuous outcomes: students' summative performance across their preclerkship courses and their Step 1 scores. The second segment presents the associations of undergraduate GPAs and MCAT scores with success on dichotomous outcomes: progressing through the first two years of medical school and passing the Step 1 exam.

Examining the associations of MCAT scores and undergraduate GPAs with medical students' performance on multiple types of outcomes provides a more complete picture of applicants' likely success in medical school.

Examining the associations of MCAT scores and undergraduate GPAs with continuous and dichotomous outcomes provides different vantage points about the likelihood of success for applicants with different ranges of undergraduate GPAs and MCAT scores. The continuous performance outcomes reveal how well academic metrics like MCAT scores and undergraduate GPAs predict performance across the full range of medical student performance. In contrast, the dichotomous outcomes reveal students' success in relation to pass/fail standards — such as progressing to clerkships on time or passing the Step 1 exam — without information about whether they scored just at, or well above, the passing standard. Knowing the value of MCAT scores in predicting students' performance on both continuous and dichotomous outcomes provides a more complete picture of applicants' likely success in medical school.

Continuous outcomes: Summative performance across preclerkship courses and Step 1 scores

This section presents the associations of MCAT scores and undergraduate GPAs with two continuous outcomes: performance across preclerkship courses and Step 1 scores from the first attempt.

The first outcome, *summative performance across preclerkship courses,* comes from students who entered medical school in 2016 and volunteered for validity research about locally defined medical student performance outcomes tied to their school's curriculum, academic support, and learning environment. These students are enrolled at 16 medical schools in the United States and Canada, referred to here as validity schools. Each school identified the preclerkship courses that have reliable performance measures; they then defined summative preclerkship performance as the mean performance across these courses.[a]

Data for the outcome *Step 1 scores from the first attempt* come from students who entered U.S. MD-granting medical schools in 2016. About 85% of the 2016 entering medical students admitted with scores from this version of the MCAT exam took the Step 1 exam by the end of 2018, and their Step 1 results are summarized in this guide. The 2016 entrants who did not take the Step 1 exam by the end of 2018 include those at medical schools whose students take the Step 1 exam after clerkships, those who delayed taking this exam for academic or other reasons, and a small percentage who withdrew or were dismissed from medical school. Many of these remaining students who did not take the Step 1 exam in their second year of medical school will likely do so by fall of their third year. The association of MCAT scores with Step 1 scores may change when the remainder of 2016 entrants take this exam; future versions of this guide will provide updated results when these Step 1 scores become available.

These two outcomes are continuous, showing distinctions across the full range of student performance. Showing the associations of MCAT scores and undergraduate GPAs with continuous performance measures may help schools identify the score ranges where students are likely to succeed without additional support, as well as the ranges where students may need academic support. Looking at the MCAT scores and undergraduate GPAs from students with modest performance in their coursework or Step 1 scores may suggest MCAT score and undergraduate GPA ranges that may signal the need for academic support. These more granular findings may give admissions committees the information they need to consider applicants with a wider range of MCAT scores and undergraduate grades and then set them up for success when they matriculate. Finally, these findings help predict students' likely performance in their preclerkship courses and on their licensure exams, which in turn affects their progression through medical school and likelihood of matching to a residency program.

Table 3 shows the organization of the results reported in this discussion of the relationships of academic metrics with the continuous outcomes.

Table 3. The Continuous Performance Outcomes, Data Sources, and Major Findings About the Associations of MCAT Scores and Undergraduate GPAs With Medical Student Performance

Performance Outcome	Source of Outcome Data	Major Findings
Summative performance across preclerkship courses	2016 entering medical students with scores from the current version of the MCAT exam at a single validity school	• On average, students admitted with higher MCAT total scores show higher performance across their preclerkship courses. • Some students showed higher performance across preclerkship courses than others admitted with the same MCAT total score, while others showed lower performance.
	2016 entering medical students with scores from the current version of the MCAT exam at 16 validity schools in the U.S. and Canada	• MCAT total scores and undergraduate GPAs each show medium to large correlations with students' performance across preclerkship courses. • Together, MCAT total scores and undergraduate GPAs provide substantially better prediction than either one alone.
Step 1 scores (first attempt) from students who took the Step 1 exam by the end of 2018	2016 entering medical students with scores from the current version of the MCAT exam at a single validity school	• On average, students admitted with higher MCAT total scores obtained higher Step 1 scores. • Some students obtained higher Step 1 scores than others admitted with the same MCAT total score, while others obtained lower Step 1 scores.
	2016 entering medical students with scores from the current version of the MCAT exam at U.S. medical schools with at least 30 students who took the Step 1 exam by the end of 2018 (N = 106)	• MCAT total scores and undergraduate GPAs each show medium to large correlations with students' Step 1 scores. • Together, MCAT total scores and undergraduate GPAs provide substantially better prediction than either one alone.
	National population of 2016 entering medical students with scores from the current version of the MCAT exam at U.S. medical schools	• On average, students admitted with higher MCAT total scores obtained higher Step 1 scores. • At every MCAT total score, there was substantial variability in Step 1 scores, and most students passed the Step 1 exam.

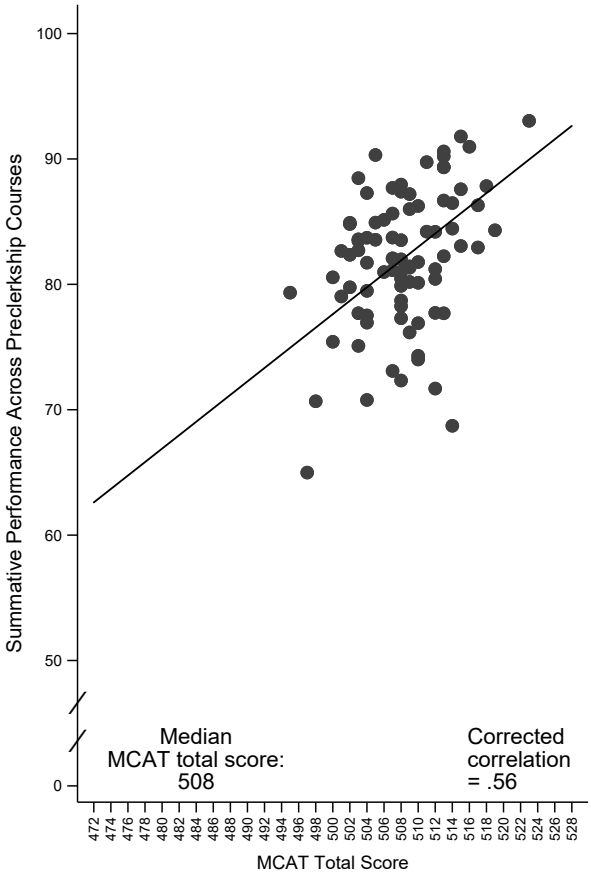
Summative performance across preclerkship courses

Figure 10 shows a scatter plot of data from one validity school, representing its medical students' MCAT scores against their summative preclerkship performance scores. Data from the students at this school can be used to study the association of MCAT scores with student performance to illustrate the patterns that may occur at other schools that use similar performance outcomes.

The X-axis shows MCAT total scores from low to high (left to right). The Y-axis shows students' preclerkship performance, on a scale from 0 to 100. Each dot shows a student's data – the MCAT score they were admitted with and their preclerkship performance. The diagonal line shows the estimated relationship of MCAT scores with summative preclerkship performance based on the correlation coefficient corrected for range restriction.[b] At this validity school, the corrected correlation of MCAT scores with summative preclerkship performance is 0.56.

The pattern of dots shows three important findings. First, this validity school accepts students with a wide range of MCAT total scores. Second, on average, participants admitted with higher MCAT total scores show higher performance across their preclerkship courses. Third, there is substantial variability in medical student performance. Some students show higher performance across preclerkship courses than others admitted with the same score, while others show lower performance. Some students with lower MCAT scores outperformed others with higher scores.

Figure 10. Scatter plot of summative performance across preclerkship courses by MCAT total score for the 2016 entering students at one validity school.



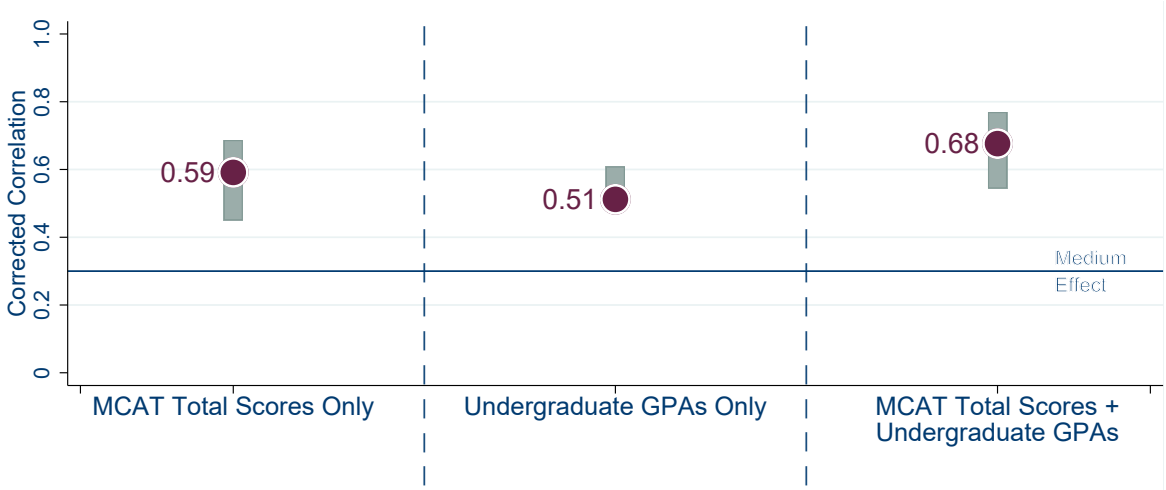
Note:

The results are for the 84 medical students who entered with scores from this version of the MCAT exam at this validity school in 2016 and who volunteered to participate in the predictive validity study. Summative performance across preclerkship courses is defined as the mean performance across preclerkship courses this validity school included in the MCAT validity research. The median MCAT total score is 508 for these 84 validity study participants and was based on the most recent MCAT score at the time of matriculation.

The correlational analysis shown in Figure 10 was done three times for each validity school — once for MCAT scores alone as the predictor, once for undergraduate GPAs alone as the predictor, and once to examine the joint contribution of MCAT total scores and undergraduate GPAs in predicting students' summative preclerkship performance. Then, the 16 correlations for each predictor were grouped together to study the midpoint and the range of correlations obtained from the validity schools.

Figure 11 shows the correlations of MCAT total scores and undergraduate GPAs, alone and together, with students' summative preclerkship performance. These findings reflect data from about 950 medical students who matriculated at 16 validity schools in 2016 with scores from the current MCAT exam and who volunteered for the study.

Figure 11. Correlations of 2016 entering students' MCAT scores and undergraduate GPAs with summative performance across preclerkship courses: Medians and interquartile ranges of correlations from 16 validity schools.



Note:

These data are for the medical students at 16 validity schools participating in local validity research. Students' most recent MCAT total scores at the time of matriculation were correlated with their performance across preclerkship course scores. Analyses were conducted separately for each school. Sample correlations were corrected for range restriction on MCAT total scores and total undergraduate GPAs due to student selection in the admissions process[13] but not for unreliability in MCAT total scores or medical student outcomes. Corrections for range restriction were made at the institution level. At each medical school, the applicants from an application cycle served as the reference population. Using established statistical methods, the observed correlations were adjusted to reflect what the correlations would be if there had been no selection — that is, if all applicants had been selected for admission. The median corrected correlation is shown with a circle, and the two ends of the gray bar show the correlations at the 25th and 75th percentiles. The horizontal line at a correlation of 0.3 shows the threshold for a medium effect size in the social sciences.

The left panel in Figure 11 shows the correlations of MCAT total scores with summative preclerkship performance at 16 individual validity schools. The 16 correlations were ranked from low to high. The circle shows the median corrected correlation (the correlation at the 50th percentile), and the two ends of the gray bar show the correlations at the 25th and 75th percentiles. The horizontal line at a correlation of 0.3 shows the threshold for a medium effect size in the social sciences.[14,c] The median correlation of MCAT total scores with summative performance across preclerkship courses is 0.59.

The middle panel in Figure 11 shows the correlations of students' total undergraduate GPAs with their summative preclerkship performance at the validity schools. The median correlation of undergraduate GPAs with summative preclerkship performance is 0.51. Finally, the right panel in Figure 11 shows the correlations of MCAT total scores and undergraduate GPAs combined in predicting summative preclerkship performance at the validity schools, which includes a median correlation of 0.68.

*Using MCAT total scores **and** undergraduate GPAs provides better prediction of preclerkship performance than using either one alone.*

Overall, the correlations of MCAT total scores with summative preclerkship performance are medium to large at these 16 validity schools. The correlations of undergraduate GPAs with summative preclerkship performance are also medium to large. The right panel in Figure 11 shows that the combination of MCAT total scores and undergraduate GPAs provides a better prediction of preclerkship performance than either one alone. Using MCAT total scores together with undergraduate GPAs provides significantly more information about students' likely performance in their preclerkship courses compared with using undergraduate GPAs alone.

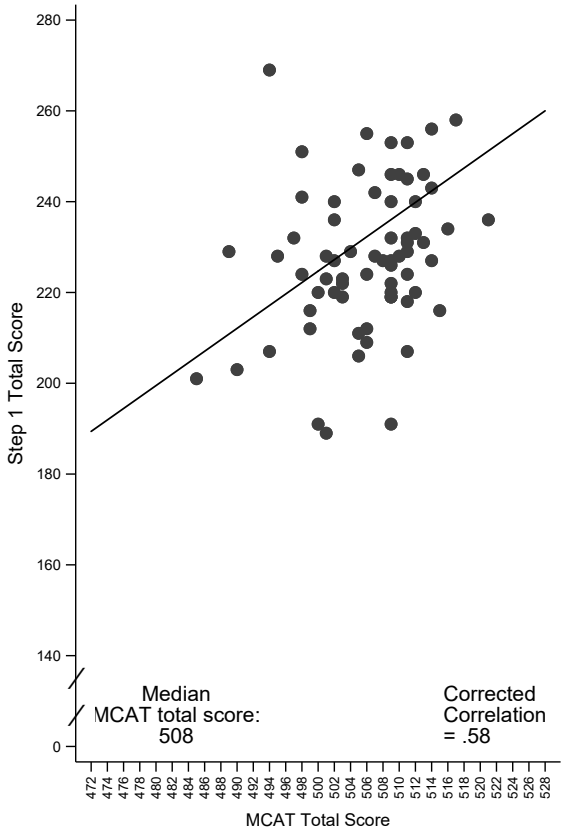
Step 1 scores from the first attempt

Analyses were also conducted to examine how well MCAT scores correlate with Step 1 scores at individual medical schools and nationally. As described previously, these data are for about 85% of the 2016 entering medical students admitted with scores from this version of the MCAT exam who took the Step 1 exam by the end of 2018. Because the association of MCAT scores with Step 1 scores may change when the remainder of 2016 entrants take this exam, future versions of this guide will provide updated results when additional Step 1 scores become available.

Figure 12 shows the association of MCAT scores with Step 1 scores at one validity school, using the same layout as shown in Figure 10. That is, the x-axis in Figure 12 shows MCAT total scores from low to high (left to right). The y-axis shows first-attempt Step 1 scores. Each dot represents the MCAT score a student was admitted with and their first-attempt Step 1 score. The diagonal line shows the estimated relationship of MCAT scores with Step 1 scores based on the correlation coefficient corrected for range restriction.[b] At this validity school, the corrected correlation of MCAT scores with Step 1 scores is 0.58.

The pattern of dots is very similar to the pattern in Figure 10. On average, participants admitted to this validity school with higher MCAT total scores obtained higher Step 1 scores, and there was substantial variability in performance. Some students showed higher Step 1 scores than others admitted with the same score, while others showed lower Step 1 scores. Some students with lower MCAT scores outperformed others with higher MCAT scores.

Figure 12. Scatter plot of first-attempt Step 1 scores by MCAT total score for 2016 entering students at one validity school.



Note:

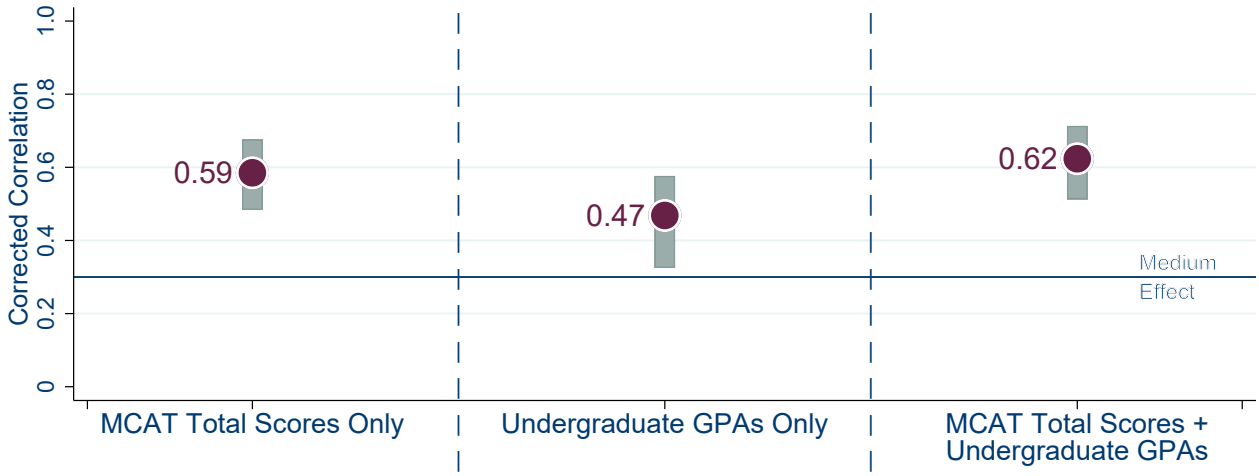
The results are for the 68 medical students who entered with scores from this version of the MCAT exam at this validity school in 2016 and who took the Step 1 exam by the end of 2018. The median MCAT total score for the students in this analysis is 508 and is based on the most recent score at the time of matriculation. The corrected correlation of MCAT scores with Step 1 scores is 0.58.

The correlational analysis shown in Figure 12 was done three times for every U.S. MD-granting medical school with at least 30 students who took the Step 1 exam by the end of 2018 — once for MCAT scores alone as the predictor, once for total undergraduate GPAs alone as the predictor, and once to examine the joint contribution of MCAT total scores and undergraduate GPAs in predicting students' Step 1 performance. Conducting these correlational analyses by school allows us to see how the correlations of academic metrics and Step 1 scores vary at schools with different curricula and student support.

Similar to Figure 11, the left panel of Figure 13 shows the correlations of MCAT total scores with Step 1 scores at the 106 U.S. MD-granting medical schools with at least 30 students who took the Step 1 exam by the end of 2018. The 106 correlations were ranked from low to high. The circle shows the median corrected correlation (the correlation at the 50th percentile), and the two ends of the gray bar show the correlations at the 25th and 75th percentiles. The horizontal line at a correlation of 0.3 shows the threshold for a medium effect size in the social sciences.[14,c] Overall, it shows that the correlations of MCAT scores with Step 1 scores are medium to large at U.S. schools. The median correlation of MCAT total scores with Step 1 scores is 0.59.

The middle panel in Figure 13 shows the correlations of undergraduate GPAs with Step 1 scores, which are also medium to large. The median correlation of undergraduate GPAs with Step 1 scores is 0.47. The right panel in Figure 13 shows that the combination of MCAT scores and undergraduate GPAs provides a better prediction of Step 1 scores than either one alone. The median correlation of MCAT scores and undergraduate GPAs with Step 1 scores is 0.62. These results are very similar to the results of the analysis of how well MCAT scores predict summative preclerkship performance (see Figure 11).

Figure 13. Correlations of 2016 entering students' MCAT scores and undergraduate GPAs with Step 1 scores from the first attempt: Medians and interquartile ranges of correlations from 106 U.S. medical schools.



Note:

These data are for the 106 U.S. medical schools with 30 or more students who took the Step 1 exam by the end of 2018 and include data from a total of 6,702 medical students enrolled in one of these schools. Medical students' most recent MCAT total scores at the time of matriculation were correlated with students' Step 1 scores from the first attempt. Analyses were conducted separately for each school. Sample correlations were corrected for range restriction on MCAT total scores and total undergraduate GPAs due to student selection in the admissions process[13] but not for unreliability in MCAT total scores or medical student outcomes. Corrections for range restriction were made at the institution level. At each medical school, the applicants from an application cycle served as the reference population. Using established statistical methods, the observed correlations were adjusted to reflect what the correlations would be if there had been no selection — that is, if all applicants had been selected for admission. The median corrected correlation is shown with a circle, and the two ends of the gray bar show the correlations at the 25th and 75th percentiles. The horizontal line at a correlation of 0.3 shows the threshold for a medium effect size in the social sciences.

Importantly, the results in Figures 11 and 13 show that using MCAT scores and undergraduate GPAs to assess academic readiness provides a better prediction of future performance in medical school and on the first licensing exam than using any single academic metric. MCAT scores should not be used as the single source of information when making decisions about students' readiness for medical school. This practice is foundational to holistic review and is a recommended best practice by the AAMC and the *Standards for Educational and Psychological Testing.*[1]

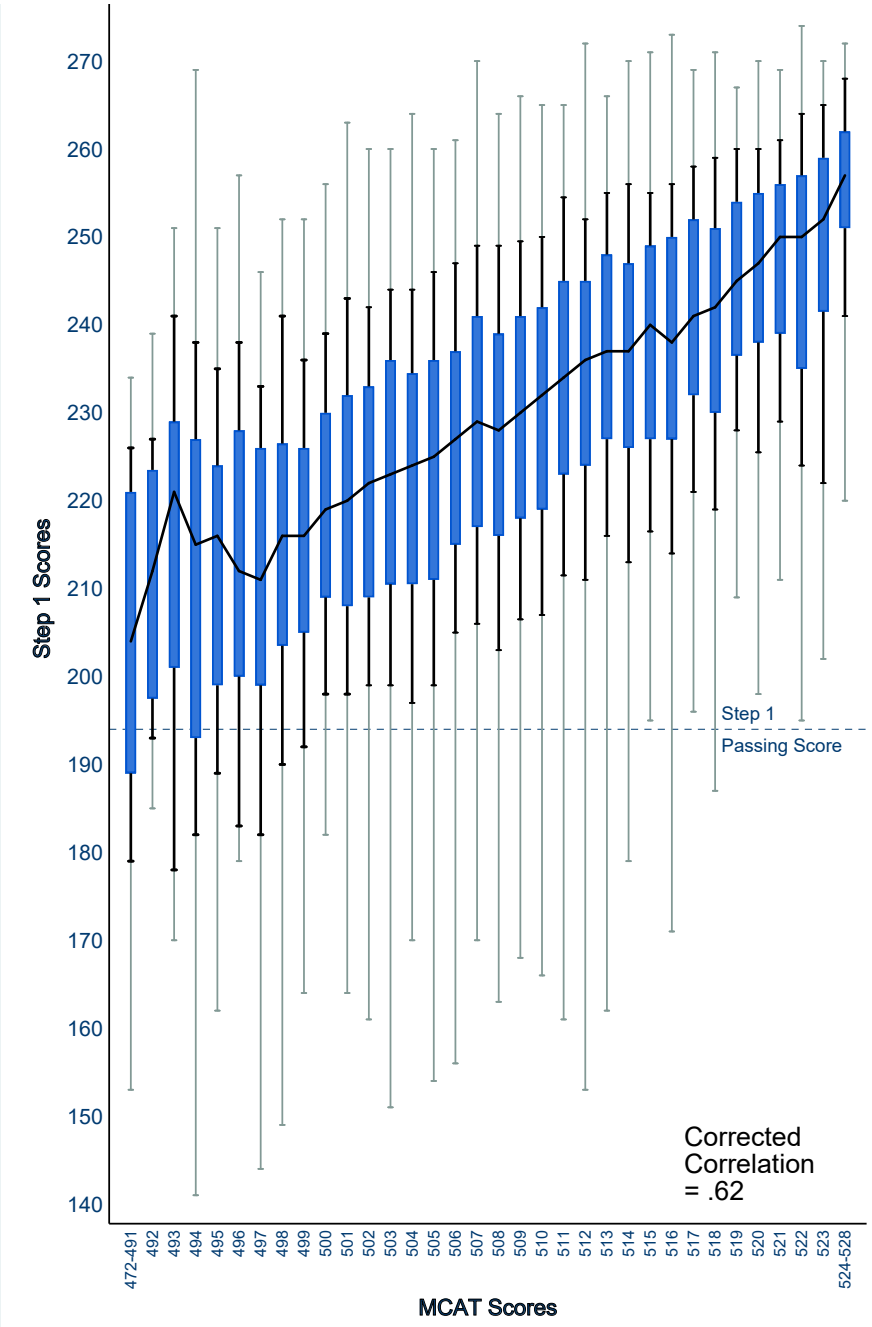
*Using MCAT total scores **and** undergraduate GPAs provides better prediction of Step 1 scores than using either one alone.*

Finally, Figure 14 shows the median and full range of Step 1 scores by MCAT total score for the 2016 entrants nationally who took the Step 1 exam by the end of 2018. The x-axis shows the MCAT total scores, and the y-axis shows the Step 1 scores. The jagged diagonal line shows the median Step 1 score for students who entered with each MCAT total score. The blue vertical boxes show the Step 1 scores at the 25th to the 75th percentiles, and the black vertical lines show the Step 1 scores at the 10th to 25th and 75th to 90th percentiles, for students who scored at each MCAT total score. The gray whiskers show the minimum and maximum Step 1 scores for students who scored at each MCAT total score. The passing score on the Step 1 exam (i.e., 194) is shown as a dashed reference line.

Figure 14 shows that, nationally and on average, 2016 entrants with higher MCAT scores obtained higher Step 1 scores. The slope of the jagged diagonal line shows that MCAT total scores are closely correlated with Step 1 scores. The correlation of MCAT total scores with Step 1 scores, corrected for range restriction to the national applicant pool, is 0.62.

The trend in Figure 14 also suggests that, at a population level, MCAT scores, which reflect students' foundational preparation in scientific concepts and reasoning skills taught in college, do a good job of predicting students' performance on a test that measures their demonstration of acquired medical knowledge from the first two years of medical school. The data suggest that the foundational preparation they start with provides the building blocks for learning in medical school.

Figure 14. Distribution of Step 1 scores by MCAT total score for 2016 entering students admitted with scores from the current version of the MCAT exam.



Note:

These data are from the 2016 entrants (N = 7,237) who took the Step 1 exam by the end of 2018. The jagged diagonal line shows the median Step 1 score for 2016 entrants by their most recent MCAT total score at the time of matriculation. The blue vertical boxes show the Step 1 scores from the 25th to the 75th percentiles, and the black vertical lines show the Step 1 scores from the 10th to the 25th percentiles and 75th to the 90th percentiles, by MCAT total score. The gray whiskers show the minimum and maximum Step 1 scores, by MCAT total score. The passing score on the Step 1 exam (i.e., 194) is shown as a dashed reference line. The numbers of students with MCAT scores at the bottom and top of the MCAT score scale are too small to be comparable with those at other points. Therefore, results for students with MCAT total scores from 472 to 491 are reported together, as are the results for those who scored from 524 to 528.

Figure 14 also shows the full range of Step 1 scores for students at each MCAT total score point. It shows that at every MCAT total score, most if not all students obtained Step 1 scores at or above the Step 1 passing score of 194, resulting in an overall pass rate of 96%. The bars showing the distribution of Step 1 scores at each MCAT total score are tall, which helps explain that — although MCAT scores do a good job of predicting Step 1 scores — at every MCAT total score, some students performed better than expected and others performed less well. As an example of the variability in Step 1 performance, for students admitted with an MCAT total score of 497, the median Step 1 score is 211. The Step 1 scores at the 25th and 75th percentiles are 199 and 226, respectively. About 15% of students with an MCAT score of 497 did not pass the Step 1 exam on their first attempt.

MCAT scores do a good job of predicting medical student performance. But, at every MCAT total score, some students perform better than predicted and others perform less well.

Figure 14 suggests that, while MCAT scores correlate highly with performance on the Step 1 exam, other factors also contribute to performance on the licensure exam. Remember, many students take the MCAT exam when they are juniors in college. They complete their senior year and then two years of medical school before taking the Step 1 exam. Significant learning happens during these years, students learn at different rates and resonate with curricular and instructional approaches in different ways, and their rank order changes over time.

Because, as described previously, some students did not take the Step 1 exam by the end of 2018, the association of Step 1 scores with MCAT scores is preliminary. The vast majority of 2016 entrants are expected to take the Step 1 exam by September 2019, including those who take it after their clerkships. Updated findings will be reported in subsequent presentations at AAMC regional and national meetings and in the next admissions officers guide.

Dichotomous outcomes: Progression to year 2 and year 3, and passing the Step 1 exam on the first attempt

This section shows the relationships between MCAT total scores, undergraduate GPAs, and several dichotomous outcomes for the national population of students who started medical school in 2016. These dichotomous outcomes are important measures of students' success in achieving major milestones and distinguish between two levels of performance — meeting or not meeting the conditions for achieving an outcome.

Table 4 shows the organization of the results reported in this discussion of the relationships of academic metrics with the dichotomous outcomes.

Table 4. The Dichotomous Performance Outcomes, Data Sources, and Major Findings About the Associations of MCAT Scores and Undergraduate GPAs With Medical Student Performance

Performance Outcome	Source of Outcome Data	Major Findings
Progression to year 2 on time	2016 entering medical students with scores from the current MCAT exam	• Overall, 96% of 2016 entrants did well in their first year and progressed to year 2 on time — the first hurdle in completing medical school with unimpeded progress. • The on-time progression rates were high for many combinations of MCAT total scores and undergraduate GPAs, although students with higher MCAT scores and undergraduate GPAs showed slightly higher on-time progression rates.
Progression to year 2 within one additional year		• Within just one additional year, 99% of 2016 entrants progressed to year 2. • Progression rates were at or near 100% for almost all combinations of MCAT scores and undergraduate GPAs.
Progression to year 3 on time		• Overall, 93% of 2016 entrants progressed to year 3 on time. • The on-time progression rates were high for many combinations of MCAT total scores and undergraduate GPAs, although students with higher MCAT scores and undergraduate GPAs showed slightly higher on-time progression rates. • It's likely that many students who did not progress to year 3 on time will do so in one additional year.
Pass the Step 1 exam on the first attempt for those who took the Step 1 exam by the end of 2018		• Overall, 96% of 2016 entrants who took the Step 1 exam by the end of 2018 passed it on the first attempt. • The Step 1 first-time pass rates were high for many combinations of MCAT total scores and undergraduate GPAs, although students with higher MCAT scores and undergraduate GPAs showed higher Step 1 pass rates.

Tables 5 to 8 show different percentages of 2016 entrants with the undergraduate GPAs and MCAT total scores who succeeded on the dichotomous outcomes — progressing through the first and second years of medical school and passing the Step 1 exam on the first attempt. Blue-shaded cells show the MCAT total score and undergraduate GPA ranges for which 90% or more students succeeded. Green-shaded cells show the same for success rates of 80% to 89%, and orange-shaded cells show the same for success rates of 70% to 79%.

Table 5. Percentage and Number of 2016 Entering Students Admitted With Scores From the Current MCAT Exam who Progressed to Year 2 on Time, by MCAT Total Score and Undergraduate GPA Range

	MCAT Total										
GPA Total	**472-485**	**486-489**	**490-493**	**494-497**	**498-501**	**502-505**	**506-509**	**510-513**	**514-517**	**518-528**	**All**
3.80-4.00		--	82% 23/28	95% 78/82	95% 229/242	97% 491/507	98% 718/732	99% 736/747	98% 570/579	>99% 474/478	98% 3,320/3,396
3.60-3.79		--	84% 27/32	93% 82/88	93% 215/230	97% 375/387	98% 527/538	97% 478/492	98% 347/355	99% 173/175	97% 2,226/2,301
3.40-3.59	--	--	83% 20/24	84% 58/69	93% 165/178	95% 231/242	95% 248/261	98% 239/245	99% 148/150	97% 71/73	95% 1,182/1,245
3.20-3.39	--	--	79% 11/14	88% 38/43	92% 78/85	91% 106/116	95% 107/113	98% 89/91	97% 60/62	100% 24/24	94% 519/555
3.00-3.19	--	--	--	100% 14/14	86% 36/42	95% 54/57	95% 41/43	86% 30/35	95% 21/22	--	91% 210/230
2.80-2.99	--	--	--	--	90% 18/20	96% 22/23	--	--	--	--	89% 67/75
2.60-2.79	--		--	--	--	--	--	--	--	--	91% 29/32
2.40-2.59		--		--	--	--	--		--		93% 13/14
2.20-2.39						--		--			--
2.00-2.19										--	--
less than 2.00											
All	50% 5/10	79% 11/14	81% 86/106	91% 281/308	93% 749/806	96% 1,287/1,341	97% 1,655/1,703	98% 1,583/1,622	98% 1,154/1,176	99% 757/765	96% 7,568/7,851

Notes:

1. Blue shading = progression rates of 90-100%; green shading = progression rates of 80-89%; orange shading = progression rates of 70-79%.
2. Dashes = cells with fewer than 10 observations; blank cells = cells with 0 observations.
3. For students who took the MCAT exam multiple times, the most recent MCAT total score was used in this analysis.
4. Students entering medical school with advanced standing from medical, graduate, or other programs, enrolled in joint programs (e.g., MD-PhD) at the time of matriculation or graduation, participating in special research/non-research studies, or deceased are not included in this table.

Table 6. Percentage and Number of 2016 Entering Students Admitted With Scores From the Current MCAT Exam who Progressed to Year 2 Within One Additional Year, by MCAT Total Score and Undergraduate GPA Range

	MCAT Total										
GPA Total	**472-485**	**486-489**	**490-493**	**494-497**	**498-501**	**502-505**	**506-509**	**510-513**	**514-517**	**518-528**	**All**
3.80-4.00		--	96% 27/28	100% 82/82	99% 239/242	>99% 505/507	>99% 727/732	>99% 743/747	>99% 574/579	>99% 475/478	>99% 3,373/3,396
3.60-3.79		--	94% 30/32	97% 85/88	98% 225/230	99% 382/387	>99% 536/538	>99% 488/492	99% 351/355	100% 175/175	99% 2,274/2,301
3.40-3.59	--	--	96% 23/24	94% 65/69	99% 176/178	98% 238/242	99% 258/261	>99% 244/245	99% 148/150	99% 72/73	99% 1,227/1,245
3.20-3.39	--	--	100% 14/14	93% 40/43	98% 83/85	97% 113/116	98% 111/113	100% 91/91	98% 61/62	100% 24/24	98% 543/555
3.00-3.19	--	--	--	100% 14/14	95% 40/42	98% 56/57	100% 43/43	94% 33/35	100% 22/22	--	97% 224/230
2.80-2.99	--	--	--	--	95% 19/20	100% 23/23	--	--	--	--	99% 74/75
2.60-2.79	--		--	--	--	--	--	--	--	--	100% 32/32
2.40-2.59		--		--	--	--	--		--		100% 14/14
2.20-2.39						--		--			--
2.00-2.19										--	--
less than 2.00											
All	80% 8/10	86% 12/14	96% 102/106	97% 298/308	98% 791/806	99% 1,325/1,341	>99% 1,691/1,703	>99% 1,611/1,622	99% 1,164/1,176	>99% 761/765	99% 7,763/7,851

Notes:

1. Blue shading = progression rates of 90-100%; green shading = progression rates of 80-89%; orange shading = progression rates of 70-79%.
2. Dashes = cells with fewer than 10 observations; blank cells = cells with 0 observations.
3. For students who took the MCAT exam multiple times, the most recent MCAT total score was used in this analysis.
4. Students entering medical school with advanced standing from medical, graduate, or other programs, enrolled in joint programs (e.g., MD-PhD) at the time of matriculation or graduation, participating in special research/non-research studies, or deceased are not included in this table.

Table 7. Percentage and Number of 2016 Entering Students Admitted With Scores From the Current MCAT Exam who Progressed to Year 3 on Time, by MCAT Total Score and Undergraduate GPA Range

	MCAT Total										
GPA Total	**472-485**	**486-489**	**490-493**	**494-497**	**498-501**	**502-505**	**506-509**	**510-513**	**514-517**	**518-528**	**All**
3.80-4.00		--	75% 21/28	85% 70/82	90% 219/242	93% 470/507	96% 702/732	96% 718/747	97% 560/579	98% 469/478	95% 3,230/3,396
3.60-3.79		--	81% 26/32	89% 78/88	88% 202/230	94% 364/387	95% 513/538	95% 469/492	96% 340/355	97% 170/175	94% 2,163/2,301
3.40-3.59	--	--	75% 18/24	80% 55/69	87% 155/178	91% 221/242	90% 235/261	96% 236/245	97% 145/150	95% 69/73	91% 1,136/1,245
3.20-3.39	--	--	79% 11/14	81% 35/43	84% 71/85	90% 104/116	93% 105/113	97% 88/91	95% 59/62	100% 24/24	90% 502/555
3.00-3.19	--	--	--	93% 13/14	81% 34/42	86% 49/57	84% 36/43	80% 28/35	91% 20/22	--	84% 194/230
2.80-2.99	--	--	--	--	85% 17/20	91% 21/23	--	--	--	--	85% 64/75
2.60-2.79	--		--	--	--	--	--	--	--	--	81% 26/32
2.40-2.59		--		--	--	--	--		--		79% 11/14
2.20-2.39						--		--			--
2.00-2.19										--	--
less than 2.00											
All	30% 3/10	71% 10/14	76% 81/106	85% 262/308	87% 705/806	92% 1,235/1,341	94% 1,603/1,703	96% 1,550/1,622	96% 1,132/1,176	98% 747/765	93% 7,328/7,851

Notes:

1. Blue shading = progression rates of 90-100%; green shading = progression rates of 80-89%; orange shading = progression rates of 70-79%.
2. Dashes = cells with fewer than 10 observations; blank cells = cells with 0 observations.
3. For students who took the MCAT exam multiple times, the most recent MCAT total score was used in this analysis.
4. Students entering medical school with advanced standing from medical, graduate, or other programs, enrolled in joint programs (e.g., MD-PhD) at the time of matriculation or graduation, participating in special research/non-research studies, or deceased are not included in this table.

Table 8. Percentage and Number of 2016 Entering Students Admitted With Scores From the Current MCAT Exam who Passed the Step 1 Exam on the First Attempt, by MCAT Total Score and Undergraduate GPA Range

	MCAT Total										
GPA Total	**472-485**	**486-489**	**490-493**	**494-497**	**498-501**	**502-505**	**506-509**	**510-513**	**514-517**	**518-528**	**All**
3.80-4.00		--	83% 19/23	89% 66/74	93% 215/232	96% 467/487	97% 682/700	>99% 708/711	>99% 564/565	>99% 437/438	98% 3,159/3,231
3.60-3.79	--	--	85% 22/26	81% 64/79	90% 180/201	95% 345/365	97% 484/501	97% 439/452	>99% 319/322	100% 150/150	96% 2,005/2,098
3.40-3.59		--	88% 15/17	74% 40/54	91% 136/150	91% 209/229	95% 221/233	99% 217/220	99% 139/141	98% 64/65	94% 1,042/1,110
3.20-3.39	--	--	60% 6/10	89% 31/35	96% 64/67	91% 96/105	97% 99/102	97% 83/86	100% 62/62	100% 25/25	94% 467/496
3.00-3.19		--		75% 9/12	86% 30/35	94% 50/53	92% 33/36	100% 26/26	95% 18/19	100% 10/10	92% 176/192
2.80-2.99	--		--	--	93% 13/14	100% 20/20	--	--	--	--	97% 58/60
2.60-2.79			--	--	--	--	--	--	--	--	89% 24/27
2.40-2.59		--		--	--	--	--		--		90% 9/10
2.20-2.39								--			--
2.00-2.19										--	--
less than 2.00											
All	--	--	82% 65/79	82% 217/264	91% 644/705	94% 1,193/1,265	97% 1,532/1,586	99% 1,484/1,506	>99% 1,109/1,116	>99% 692/694	96% 6,942/7,226

Notes:

1. Blue shading = pass rates of 90-100%; green shading = pass rates of 80-89%; orange shading = pass rates of 70-79%.
2. Dashes = cells with fewer than 10 observations; blank cells = cells with 0 observations.
3. For students who took the MCAT exam multiple times, the most recent MCAT total score was used in this analysis.
4. About 15% of 2016 entrants did not take the Step 1 exam by the end of 2018.

Overall, 96% of 2016 entrants with scores from the current version of the MCAT exam did well in their first year and progressed to year 2 on time — the first hurdle in completing medical school with unimpeded progress. Table 5 shows that students with a wide range of undergraduate GPAs and MCAT scores progressed to year 2 on time. The percentages in the cells of Table 5 show that on-time progression to year 2 was high for many combinations of undergraduate GPAs and MCAT scores, although higher undergraduate GPAs and MCAT scores generally are associated with slightly higher on-time progression rates.

Table 6 shows that 99% of these 2016 entering medical students progressed to year 2 within one additional year. Progression rates were at or near 100% for almost all combinations of MCAT scores and undergraduate GPAs.

Table 7 shows the relationships between undergraduate GPAs, MCAT scores, and on-time progression to year 3. These data show that 93% of the 2016 entrants with scores from this exam progressed to year 3 on time. The pattern of results show that most students progress on time, including those who entered with modest MCAT scores. The cells of Table 7 also show that higher undergraduate GPAs and MCAT scores are generally associated with higher on-time progression rates to year 3. As reported in a recent *AAMC Data Snapshot,* five-year graduation rates have consistently remained at 95% for more than two decades.[15] If this trend continues, many of the students who did not progress to year 3 on time will do so within one extra year.

Table 8 shows the same type of relationships between undergraduate GPAs, MCAT scores, and Step 1 pass rates. These data show that 96% of the 2016 entrants with scores from this version of the MCAT exam who took the Step 1 exam by the end of 2018 passed it on the first attempt. These data also show positive relationships of undergraduate GPAs and MCAT scores with first-time pass rates on the Step 1 exam.

Students with a wide range of MCAT scores and undergraduate GPAs progress to years 2 and 3 on time and pass the Step 1 exam on the first attempt.

As described previously, the Step 1 pass rates in Table 8 are for the 85% of 2016 entrants admitted with scores from the current version of the MCAT exam who took the Step 1 exam by the end of 2018. These pass rates should be interpreted tentatively and may change when the rest of the students in this entering class take the Step 1 exam. Step 1 pass rates will be updated in presentations for national and regional meetings and in next year's version of this guide, once these data become available.

Together, the information in this section shows that the MCAT exam is doing its job in assessing applicants' academic readiness for medical school. Figures 11 and 13 show that MCAT total scores, alone and together with undergraduate GPAs, demonstrate value in predicting applicants' likely preclerkship and Step 1 performance. Tables 5 to 8 also show that medical students with a wide range of MCAT scores and undergraduate GPAs succeed in medical school, progressing through their first two years and passing the Step 1 exam on the first attempt.

MCAT scores and undergraduate GPAs do a good job of predicting students' preclerkship and Step 1 performance, ***and yet*** *students with a wide range of metrics progress on time and pass the Step 1 exam on the first attempt.*

This raises the question: "How can it be true that MCAT scores and undergraduate GPAs predict students' performance on continuous outcomes, and yet most students progress on time?" Many reasons might contribute to this apparent contradiction. One important factor involves the granularity of the outcome measures. Continuous measures allow for finer distinctions in students' performance, whereas dichotomous outcomes, like progressing to year 3 on time, show only if students achieve the conditions for progressing, not how far above or below the conditions they fall.

Other important explanations exist. When admissions officers and their committees admit students with more modest MCAT scores and undergraduate GPAs, they do so because these applicants stand out to them as capable of succeeding and contributing to teaching and learning at their schools. Information in these applicants' experiences, attributes, and academic preparation lead admissions committees to believe these applicants can succeed at their schools.

These data also reinforce that medical schools support the students they admit. Some students who may have faced academic or other challenges were able to succeed because of their efforts and their school's support — nationally, 96% of 2016 entrants admitted with scores from this version of the exam progressed to year 2 on time; 99% progressed to year 2 within one additional year; and 93% progressed to year 3 on time.

Each medical school admits classes of students that will help meet its educational, research, community service, and health care mission and goals by carefully considering the rich and assorted data that applicants provide about their experiences, attributes, and academic preparation. Faculty work with their students by using their curricula, academic support, and learning environments, which are tailored to their school's educational goals and their students' needs. In place at each medical school are also different levels of social and wellness support services (see, for example, the 2018 innovation report in *Academic Medicine* by Elks et al.).[16] Results from this validity research show that MCAT scores are only one signal of students' likely success and that other factors also shape performance.

Conclusions and next steps

This is the first large-scale study on the predictive validity of scores from the current version of the MCAT exam. It supports the use of MCAT scores, together with other application data that are important for admissions decisions. The predictive validity findings in this section are consistent with those from the previous version of the MCAT exam, which show the value of scores from the old MCAT exam in predicting students' performance in medical school and on licensure exams.[d] Studies show that undergraduate grades and scores from the old MCAT exam predict students' grades in medical school, academic difficulty or distinction, scores on USMLE Step exams, time to graduation, and unimpeded progress toward graduation.[2,17-21] Future research will examine how well scores from this version of the MCAT exam predict these same outcomes, as medical students in the current study make their way through medical school.

The preliminary results are promising. There is a lot more to learn about how students fare in the remaining years of medical school and whether they graduate on time according to each medical school's curriculum. Future reports will summarize the research into the predictive validity of MCAT scores for performance in clerkships, on the Step 2-CK and Step 2-CS exams, and graduation within four or five years. They will include findings based on data from these and additional cohorts of medical students.

Future research will include findings about the associations of MCAT scores and undergraduate GPAs with performance in clerkships and on the Step 2-CK and Step 2-CS exams, and graduation within four or five years.

Appendix C provides more context about the complete agenda to evaluate the fairness, impact, use, and predictive validity of this version of the MCAT exam. This summer, *Academic Medicine* will publish a collection of articles summarizing the findings so far. Included in these findings are data about how well MCAT scores predict students' performance in the first year of medical school,[22] how examinees prepare for and perform on the exam,[23] how admissions committees can admit more diverse classes by considering applicants with a wider range of MCAT scores,[24] and how to help students strategically prepare for the exam.[25] Visit academicmedicine.org to read the articles.

Findings about the value of MCAT scores and undergraduate GPAs in predicting students' clerkship performance, performance on the Step 2-CK and Step 2-CS exams, and graduation within four or five years for this and future cohorts will be released each year in this guide, on the AAMC website (aamc.org/admissions), in peer-reviewed publications, and at regional and national meetings.

Notes

a. Examples of preclerkship courses are: 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 vary widely in the extent to which they relate to the knowledge and skills that the MCAT exam tests, most teach natural sciences subjects. Because the courses selected by each validity school made up the majority of preclerkship courses at the school, the summative measure of performance, which ranges from 0 to 100, correlated highly with the preclerkship GPAs that were calculated by the medical schools or with class ranks at each school.

b. Corrections for range restriction were made at the institution level. At each medical school, the 2017 applicants served as the reference population, as there were more applicants who applied with scores from the current MCAT exam. Using established statistical methods, the observed correlations were adjusted to reflect what the correlation would be for all applicants to a school if there had been no selection — that is, if all students had been selected for admission and were provided the same support throughout medical school as those provided for matriculants.

c. According to Cohen (1992),[14] a correlation coefficient of 0.10 is considered a small association in the social sciences; a correlation coefficient of 0.30 is considered a medium correlation; and a correlation of 0.50 or greater is considered a large correlation.

d. For example, at 17 validity schools, the median corrected correlation of MCAT scores with 2015 entering students' summative preclerkship performance was 0.54, as reported at Learn Serve Lead 2018: The AAMC Annual Meeting in Austin, Texas. All the 2015 entrants at these schools were admitted with scores from the previous version of the MCAT exam. Other studies have reported similar results — that correlations of MCAT scores from the previous version of the MCAT exam with preclerkship performance and Step 1 performance are medium to large.

References

1. American Educational Research Association; American Psychological Association; National Council on Measurement in Education. *Standards for Educational and Psychological Testing*. Washington DC: American Educational Research Association; 2014;198.

2. Dunleavy DM, Kroopnick MH, Dowd KW, Searcy CA, Zhao X. The predictive validity of the MCAT exam in relation to academic performance through medical school: a national cohort study of 2001-2004 matriculants. *Acad Med*. 2013;88(5):666-671.

3. Association of American Medical Colleges. *2018 Post-MCAT Questionnaire Summary Report*. Washington, DC: AAMC; 2019. www.aamc.org/data/pmq. Accessed February 2019.

4. Roth PL, Bevier CA, Bobko P, Switzer FS III, Tyler P. Ethnic group differences in cognitive ability in employment and educational settings: a meta-analysis. *Pers Psychol*. 2001;54(2):297-330.

5. Sackett PR, Shen W. Subgroup differences on cognitive tests in contexts other than personnel selection. In: Outtz JL, ed. *Adverse Impact: Implications for Organizational Staffing and High Stakes Selection*. New York, NY: Taylor & Francis Group; 2010;323-346.

6. Davis D, Dorsey JK, Franks RD, Sackett PR, Searcy CA, Zhao X. Do racial and ethnic group differences in performance on the MCAT exam reflect test bias? *Acad Med*. 2013;88(5):593-602.

7. Mitchell K, Haynes R, Koenig JA. Assessing the validity of the updated Medical College Admission Test. *Acad Med*. 1994;69(5):394-401.

8. Monroe A, Quinn E, Samuelson W, Dunleavy D, Dowd K. An overview of the medical school admission process and use of applicant data in decision making: what has changed since the 1980s? *Acad Med*. 2013;88:672-681.

9. Association of American Medical Colleges. AAMC Admissions Initiative. Unpublished data. 2013.

10. Association of American Medical Colleges, SRA International, Inc. *Survey of Admissions Officers About the Use and Importance of Medical College Admission Test (MCAT) Scores in Medical School Admissions: U.S. Data Display and Table Survey Results*. Washington, DC: AAMC; 2016.

11. Association of American Medical Colleges. MCAT Validity Committee. Unpublished data. 2017.

12. Dunleavy DM, Sondheimer H, Castillo-Page L, Bletzinger RB. Medical school admissions: more than grades and test scores. *Analysis in Brief*. 2011;11(6). www.aamc.org/download/261106/data/aibvol11_no6.pdf.

13. Betty AS, Barratt CL, Berry CM, Sackett PR. Testing the generalizability of indirect range restriction corrections. *J Appl Psychol*. 2014;99(4):587-598.

14. Cohen J. A power primer. *Psychol Bull*. 1992;112(1):155-159.

15. Association of American Medical Colleges. *Data Snapshot: Graduation Rates and Attrition Rates of U.S. Medical Students.* Washington, DC: AAMC; 2018. www.aamc.org/download/492842/data/.

16. Elks ML, Herbert-Carter J, Smith M, Klement B, Knight BB, Anachebe N. Shifting the curve: fostering academic success in a diverse student body. *Acad Med.* 2018;93(1):66-70.

17. Donnon T, Paolucci EO, Violato C. The predictive validity of the MCAT for medical school performance and medical board licensing examinations: a meta-analysis of the published research. *Acad Med.* 2007;82(1):100-106.

18. Julian ER. Validity of the Medical College Admission Test for predicting medical school performance. *Acad Med.* 2005;80(10):910-917.

19. Koenig JA, Wiley A. Medical school admission testing. In: Dillon RF, ed. *Handbook on Testing.* Westport, CT: Greenwood Press; 1997;274-295.

20. Kroopnick MH, Dunleavy DM, Dowd KW, Searcy CA, Zhao X. A comprehensive school-level analysis of the predictive validity of the Medical College Admission Test (MCAT). Paper presented at: the 2013 American Educational Research Association Annual Meeting; April 27-May 1, 2013; San Francisco, CA.

21. Kuncel NR, Hezlett SA. Standardized tests predict graduate students' success. *Science.* 2007;315(5815):1080-1081.

22. Busche K, Elks ML, Hanson JT, Jackson-Williams L, Manuel RS, Parsons WL, Wofsy D, Yuan K. The validity of scores from the new Medical College Admission Test (MCAT®) in predicting student performance: results from a multisite study. *Acad Med.* In press.

23. Girotti JA, Chanatry JA, Clinchot DM, McClure SC, Swan-Sein A, Walker IW, Searcy CA. Investigating group differences in preparation and performance on the new Medical College Admission Test (MCAT®). *Acad Med.* In press.

24. 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.* In press.

25. Swan-Sein A, Cuffney F, Clinchot DM. How to help students strategically prepare for the MCAT® exam and learn the foundational knowledge needed for medical school. *Acad Med.* In press.

26. Association of American Medical Colleges, Howard Hughes Medical Institute. *Scientific Foundations for Future Physicians Committee*. Washington, DC: AAMC; 2009. www.aamc.org/scientificfoundations.

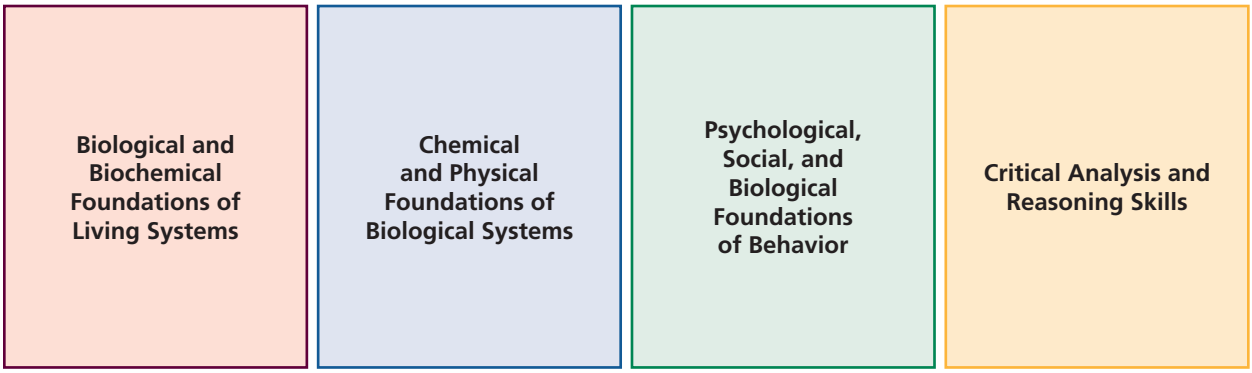
27. Association of American Medical Colleges. *Behavioral and Social Science Foundations for Future Physicians.* Washington, DC: AAMC; 2011. www.aamc.org/socialsciencefoundations.

28. Schwartzstein RM, Rosenfeld GC, Hilborn R, Oyewole SH, Mitchell K. Redesigning the MCAT exam: balancing multiple perspectives. *Acad Med.* 2013;88(5):560-567.

Appendix A. Description of the Foundational Concepts, Scientific Inquiry and Reasoning Skills, and Information-Processing Skills Tested on the Four Sections of the MCAT Exam

Appendix A provides descriptions of the foundational concepts, content categories, and ways that examinees demonstrate their scientific inquiry and reasoning skills on the three sections of the MCAT exam that assess academic preparation in the natural, behavioral, and social sciences. It also describes the ways that examinees demonstrate their information-processing skills in the Critical Analysis and Reasoning Skills section.

The concepts tested in each section align with concepts medical school faculty, residents, and medical students rated as important to the success of entering students. They are organized around the academic competencies described by seminal reports such as the *Scientific Foundations for Future Physicians* (2009) and the *Behavioral and Social Science Foundations for Future Physicians* (2011).[26, 27] To read more about the quantitative and qualitative research that supports the design and development of the MCAT exam, visit aamc.org/mr5mcatcollection and refer to Schwartzstein et al. (2013).[28]



Biological and Biochemical Foundations of Living Systems

Medical school applicants must be prepared to learn about the biological and biochemical concepts that contribute to health and disease. When they enter medical school, they must be ready to learn how:

- The major biochemical, genetic, and molecular functions of the cell support health and lead to disease.
- Cells grow and integrate to form tissues and organs that carry out essential biochemical and physiological functions.
- The body responds to internal and external stimuli to support homeostasis and the ability to reproduce.

The Biological and Biochemical Foundations of Living Systems section tests three foundational concepts and several reasoning skills that are building blocks for learning in medical school. This section asks examinees to solve problems by combining their knowledge of foundational concepts from biology, biochemistry, general chemistry, and organic chemistry with their scientific inquiry and reasoning skills.

Figure A.1 lists the foundational concepts and the more specific content categories tested within each foundational concept. It also provides examples of the ways examinees are asked to combine their knowledge of foundational concepts with their scientific reasoning skills to answer test questions in this section.

Figure A.1. Foundational concepts, content categories, and scientific inquiry and reasoning skills tested on the Biological and Biochemical Foundations of Living Systems section.

Biological and Biochemical Foundations of Living Systems		
Foundational Concept 1 Biomolecules have unique properties that determine how they contribute to the structure and function of cells and how they participate in the processes necessary to sustain life.	**Foundational Concept 2** Highly organized assemblies of molecules, cells, and organs interact to carry out the functions of living organisms.	**Foundational Concept 3** Complex systems of tissues and organs sense the internal and external environments of multicellular organisms and, through integrated functioning, maintain a stable internal environment within an ever-changing external environment.
Content Categories • Structure and functions of protein and their constituent amino acids. • Transmission of genetic information from the gene to the protein. • Transmission of heritable information from generation to generation and the processes that increase genetic diversity. • Principles of bioenergetics and fuel molecule metabolism.	**Content Categories** • Assemblies of molecules, cells, and groups of cells within singular cellular and multicellular organisms. • The structure, growth, physiology, and genetics of prokaryotes and viruses. • Processes of cell division, differentiation, and specialization.	**Content Categories** • Structure and functions of the nervous and endocrine systems and ways in which the systems coordinate the organ systems. • Structure and integrative functions of the main organ systems.
Questions in this section of the test ask examinees to combine their knowledge of the foundational concepts listed above with their scientific inquiry and reasoning skills. Questions in this section might ask examinees to: • Recall the structural characteristics of two tissues and relate them to one another. • Apply their understanding of Le Châtelier's Principle to explain differences in deprotonation of organic acids when added to blood vs. pure water. • Use knowledge of adaptive immune response to evaluate the acceptability of a treatment for use in a clinical context. • Form a hypothesis about the effect of the pineal gland on thermogenesis based on the data from an experiment investigating the interaction of temperature and pineal gland activity on body and organ weights for hamsters under different experimental conditions. • Use data about wavelength and light absorption to determine the color perception of an individual with a given phenotype.		

Chemical and Physical Foundations of Biological Systems

Medical school applicants must be prepared to learn about the mechanical, physical, and biochemical functions of human tissues, organs, and organ systems and how these contribute to health and disease. When they enter medical school, they must be ready to learn about:

- The physiological functions of the respiratory, cardiovascular, and neurological systems in health and disease.
- Molecular and cellular functions in health and disease.

The Chemical and Physical Foundations of Biological Systems section tests two foundational concepts and several reasoning skills that are building blocks for learning in medical school. This section asks test takers to solve problems by combining their knowledge of foundational concepts from biology, biochemistry, physics, and general and organic chemistry with their scientific inquiry and reasoning skills.

Figure A.2 lists the foundational concepts and content categories tested in this section. It also provides examples of the ways examinees are asked to combine their knowledge of foundational concepts with their scientific inquiry and reasoning skills to answer test questions in this section.

Figure A.2. Foundational concepts, content categories, and scientific inquiry and reasoning skills tested on the Chemical and Physical Foundations of Biological Systems section.

Chemical and Physical Foundations of Biological Systems	
Foundational Concept 4 Complex living organisms transport materials, sense their environment, process signals, and respond to changes using processes that can be understood in terms of physical principles.	**Foundational Concept 5** The principles that govern chemical interactions and reactions form the basis for a broader understanding of the molecular dynamics of living systems.
Content Categories • Translational motion, forces, work, energy, and equilibrium in living systems. • Importance of fluids for the circulation of blood, gas movement, and gas exchange. • Electrochemistry and electrical circuits and their elements. • How light and sound interact with matter. • Atoms, nuclear decay, electronic structure, and atomic chemical behavior.	**Content Categories** • Unique nature of water and its solutions. • Nature of molecules and intermolecular interactions. • Separation and purification methods. • Structure, function, and reactivity of biologically relevant molecules. • Atoms, nuclear decay, electronic structure, and atomic chemical behavior.
Questions in this section of the test ask examinees to combine their knowledge of the foundational concepts listed above with their scientific inquiry and reasoning skills. Questions in this section might ask examinees to: • Identify the relationship between the distribution of electric charges in the axon and the electric field lines they produce. • Recognize the principles of flow characteristics of blood in the human body and apply the appropriate mathematical model to an unfamiliar scenario. • Change the experimental conditions of a test for proteins in a solution to prevent the formation of precipitates. • Select between the standard and Doppler ultrasound techniques for a given context, considering the appropriateness, precision, and accuracy of each technique. • Use, analyze, and interpret data in a graph to determine the half-life of a radioactive substance used to measure cardiac function.	

Psychological, Social, and Biological Foundations of Behavior

Medical school applicants must be prepared to learn about the impact of behavioral and sociocultural factors on illness and health outcomes. When they enter medical school, they must be ready to learn how:

- Cognitive and perceptual processes influence the understanding of health and illness.
- Behavior can either support health or increase risk for disease.
- Perception, attitudes, and beliefs influence interactions with patients and other members of the health care team.
- Patients' social and demographic backgrounds influence their perceptions of health and disease, the health care team, and therapeutic interventions.
- Social and economic factors can affect access to care and the probability of maintaining health and recovering from disease.

The Psychological, Social, and Biological Foundations of Behavior section tests five foundational concepts and several reasoning skills in the behavioral and social sciences that are building blocks for learning in medical school. This section tests the foundational concepts in psychology, sociology, and biology that tomorrow's doctors need to serve an increasingly diverse population and have a clear understanding of the impact of behavior and sociocultural differences on health. Like the natural sciences sections, this section asks test takers to solve problems by combining their knowledge of foundational concepts with their scientific inquiry and reasoning skills. It does not measure applicants' interpersonal skills, the way they will behave, or their attitudes and beliefs about social issues.

Figure A.3 lists the foundational concepts tested in this section. It also provides examples of the ways examinees are asked to combine their knowledge of foundational concepts with their scientific inquiry and reasoning skills to answer test questions in this section.

Figure A.3. Foundational concepts, content categories, and scientific inquiry and reasoning skills tested on the Psychological, Social, and Biological Foundations of Behavior section.

Psychological, Social, and Biological Foundations of Behavior				
Foundational Concept 6 Biological, psychological, and sociocultural factors influence the ways that individuals perceive, think about, and react to the world.	**Foundational Concept 7** Biological, psychological, and sociocultural factors influence behavior and behavior change.	**Foundational Concept 8** Psychological, sociocultural, and biological factors influence the way we think about ourselves and others.	**Foundational Concept 9** Cultural and social differences influence well-being.	**Foundational Concept 10** Social stratification and access to resources influence well-being.
Content Categories • Sensing the environment. • Making sense of the environment. • Responding to the world.	**Content Categories** • Individual influences on behavior. • Social processes that influence human behavior. • Attitude and behavior change.	**Content Categories** • Self-identity. • Social thinking. • Social interactions.	**Content Categories** • Understanding social structure. • Demographic characteristics and processes.	**Content Categories** • Social inequity.
Questions in this section of the test ask examinees to combine their knowledge of foundational concepts listed above with their scientific inquiry and reasoning skills. Questions in this section might ask examinees to: • Draw conclusions about the type of memory affected by an experimental manipulation when shown a graph of findings from a memory experiment. • Reason about whether a causal explanation is possible when given an example of how personality predicts individual behavior. • Distinguish the kinds of claims that can be made when using longitudinal data, cross-sectional data, or experimental data in studies of social interaction. • Identify the relationship between demographic variables and health variables reported in a table or figure. • Identify the relationship between social institutions that is suggested by an illustration used in a public health campaign.				

Critical Analysis and Reasoning Skills

The structure of the Critical Analysis and Reasoning Skills section is different from the structure of the other sections of the exam. It asks applicants to process information, solve problems, and draw conclusions from information that is presented in passages. Medical students are required to comprehend and analyze a great deal of information in different contexts, and this section has been developed specifically to assess the information-processing skills an applicant will need to be successful in medical school.

The Critical Analysis and Reasoning Skills section tests how well applicants comprehend, analyze, and evaluate what they read; draw inferences from text; and apply arguments to new ideas and situations. It tests examinees' ability to process information by having them read passages from a diverse set of disciplines in the humanities and social sciences. These passages are excerpted from the kinds of books, journals, and magazines that college students are likely to read.

All passages in this section of the MCAT exam consist of multiple paragraphs and require thoughtful reading. Students must grasp the meaning of each paragraph and also identify the relationships across paragraphs. Additionally, students need to attend to the authors' stated and unstated assumptions and to the rhetorical choices they have made to develop stance, voice, and style. Some passages require an understanding of the authors' interpretations, implications, or applications of historical accounts, theories, observations, or societal trends.

The questions that follow the passages require their own focused kinds of reading, analyzing, and reasoning because many ask students to think about the passages from different perspectives or to question the authors' statements, judge the relevance of the authors' examples, or consider crucial facts that might challenge the authors' assertions or analysis. It is important to keep in mind that the questions in this section do not rely on specific background knowledge in the humanities and social sciences. Students get all the information they need to answer the questions in the accompanying passages or in the questions themselves.

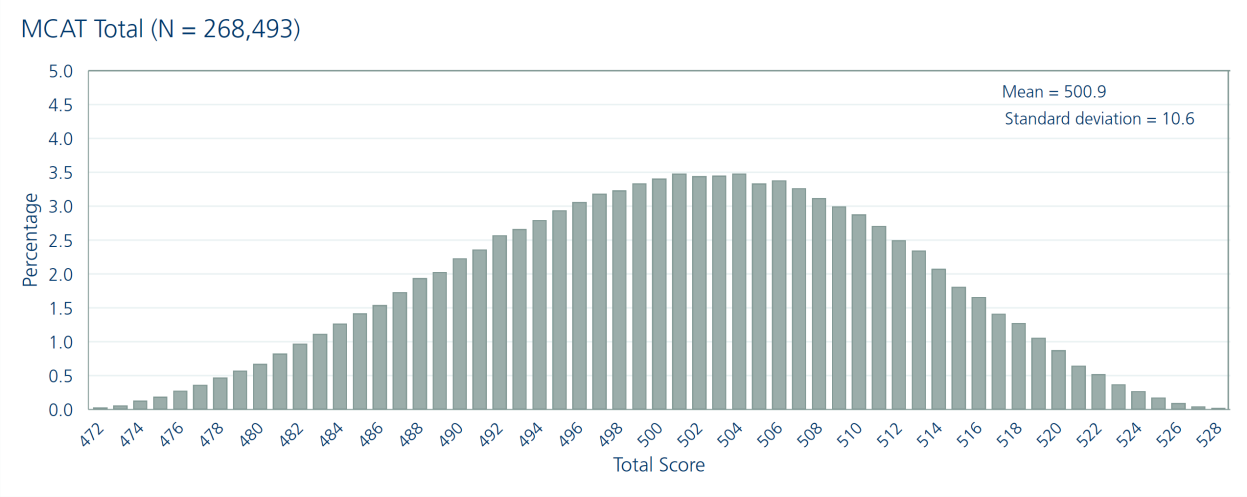
The Critical Analysis and Reasoning Skills section assesses three broad critical analysis and reasoning skills: Foundations of Comprehension, Reasoning Within the Text, and Reasoning Beyond the Text. The major elements of each skill are described in Figure A.4.

Figure A.4. Analysis and reasoning skills tested on the Critical Analysis and Reasoning Skills section.

Critical Analysis and Reasoning Skills
Foundations of Comprehension Questions measuring Foundations of Comprehension ask examinees to demonstrate their information-processing skills by: • Understanding the basic components of the text, such as the main idea of the passage, the conclusions drawn by the author, and the intended meaning of specific words or phrases. • Inferring meaning from rhetorical devices, word choice, and text structure, such as the use of loaded adjectives that reveal whether an author is objectively conveying factual information or a bias about an issue, the use of point-counterpoint to describe two perspectives on an issue, or the use of sarcasm or symbolism that signals that words should not be taken literally.
Reasoning Within the Text Questions measuring Reasoning Within the Text ask examinees to demonstrate their information-processing skills by: • Integrating different components of the text to increase comprehension or analysis, such as identifying sections of a passage that support an author's position, identifying assumptions that underlie a position taken, distinguishing between opinion and fact, or judging the veracity of an argument.
Reasoning Beyond the Text Questions measuring Reasoning Beyond the Text ask examinees to demonstrate their information-processing skills by: • Applying or extrapolating ideas from the passage to new contexts, situations, possibilities, alternatives, options, or proposals, such as identifying a new scenario that is consistent with an author's point of view or a relationship described in the passage. • Assessing the impact of introducing new factors, information, or conditions to ideas from the passage to evaluate students' understanding that inferences and conclusions may change in the face of new information.

Appendix B. Summary of MCAT Total and Section Scores

MCAT Total Scores and Percentile Ranks in Effect May 1, 2019-April 30, 2020



Total Score	Percentile Rank
472	<1
473	<1
474	<1
475	<1
476	1
477	1
478	2
479	2
480	3
481	4
482	5
483	6
484	7
485	8
486	10
487	12
488	14
489	16
490	18

Total Score	Percentile Rank
491	20
492	23
493	25
494	28
495	31
496	34
497	37
498	41
499	44
500	47
501	51
502	54
503	58
504	61
505	65
506	68
507	71
508	74
509	77

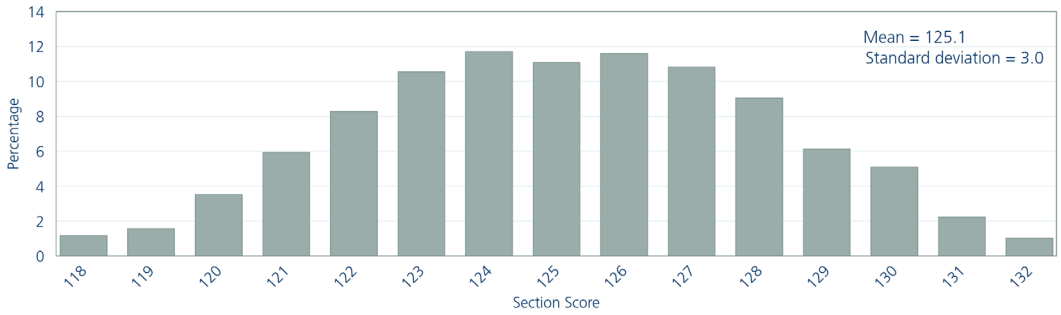
Total Score	Percentile Rank
510	80
511	83
512	85
513	88
514	90
515	92
516	93
517	95
518	96
519	97
520	98
521	99
522	99
523	99
524	100
525	100
526	100
527	100
528	100

Notes:

- The column labeled "Percentile Rank" provides the percentage of scores equal to or less than each score point. These percentile ranks are based on all MCAT results from the 2016-2018 testing years combined. For example, 74% of MCAT total scores were equal to or less than 508 across all exams administered in 2016-2018 combined.
- Updates to the percentile ranks will be made on May 1st each year and will be based on exams administered in the three most recent test administration years.

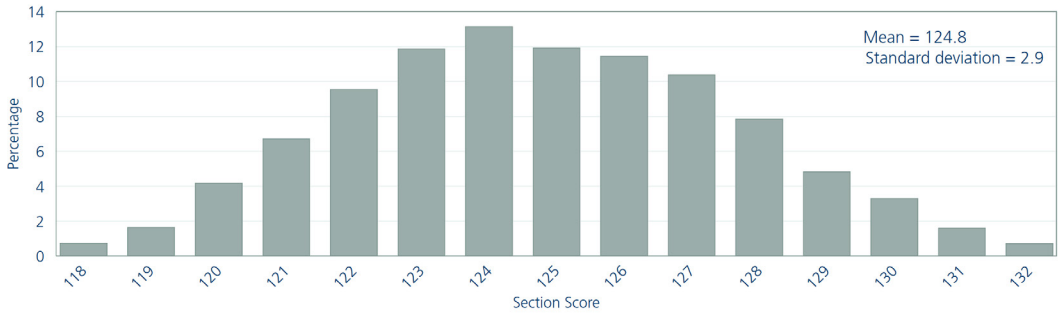
MCAT Section Scores and Percentile Ranks in Effect May 1, 2019-April 30, 2020

Chemical and Physical Foundations of Biological Systems



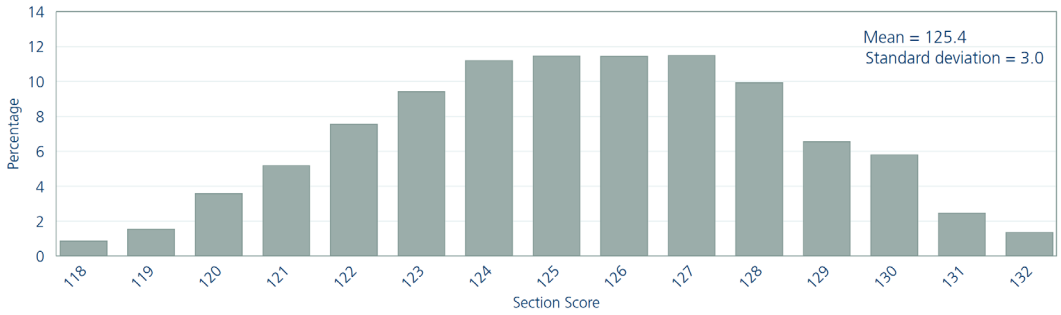
Total Score	Percentile Rank
118	1
119	3
120	6
121	12
122	21
123	31
124	43
125	54
126	66
127	76
128	85
129	92
130	97
131	99
132	100

Critical Analysis and Reasoning Skills



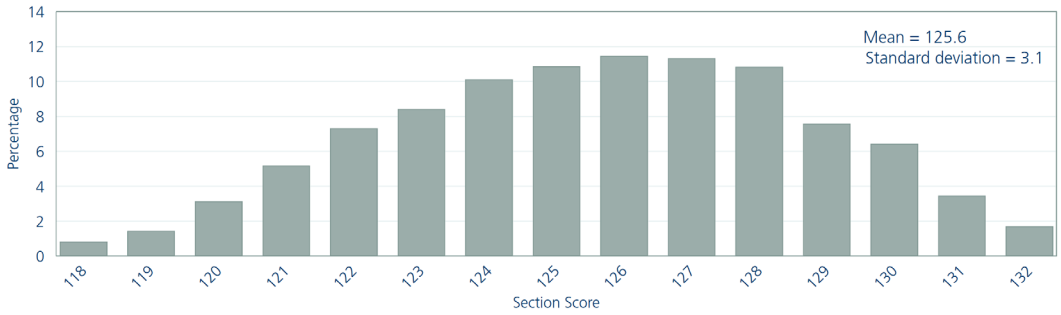
Total Score	Percentile Rank
118	1
119	2
120	7
121	13
122	23
123	35
124	48
125	60
126	71
127	82
128	90
129	94
130	98
131	99
132	100

Biological and Biochemical Foundations of Living Systems



Total Score	Percentile Rank
118	1
119	2
120	6
121	11
122	19
123	28
124	39
125	51
126	62
127	74
128	84
129	90
130	96
131	99
132	100

Psychological, Social, and Biological Foundations of Behavior



Total Score	Percentile Rank
118	1
119	2
120	5
121	11
122	18
123	26
124	36
125	47
126	59
127	70
128	81
129	88
130	95
131	98
132	100

Appendix C. MCAT Validity Research

The research findings presented in this guide come from a research collaborative evaluating the validity, fairness, impact, and use of scores from the MCAT exam introduced in 2015. Beginning in 2012, representatives from medical schools in the U.S. and Canada studied the meaning and value of scores from the Psychological, Social, and Biological Foundations of Behavior section of the MCAT exam. Their early work laid the foundation for the present research, led by representatives from medical schools and prehealth advisors from undergraduate institutions serving on the MCAT Validity Committee (MVC).

The MVC members are admissions and student affairs officers, education deans, and researchers from medical schools, as well as prehealth advisors in current and previous leadership positions of the National Association of Advisors for the Health Professions. The medical schools were selected from 65 institutions across North America that volunteered to participate in the MCAT validity research. The validity schools represent a wide range of institutional missions, geographic regions, and institution types (public or private). They are also diverse with respect to their applicant pool sizes and characteristics, curricula, instruction, and grading systems.

Table C.1. Medical Schools Participating in MCAT Validity Research

Participating Medical School	
Boston University School of Medicine	Tulane University School of Medicine
Columbia University Vagelos College of Physicians and Surgeons	University of Arizona College of Medicine - Tucson
East Tennessee State University James H. Quillen College of Medicine	University of Calgary Cumming School of Medicine
Meharry Medical College School of Medicine	University of California, San Francisco, School of Medicine
Memorial University of Newfoundland Faculty of Medicine	University of Central Florida College of Medicine
Morehouse School of Medicine	University of Illinois College of Medicine at Chicago
Philadelphia College of Osteopathic Medicine	University of Mississippi School of Medicine
Rutgers Robert Wood Johnson Medical School	University of North Carolina at Chapel Hill School of Medicine
Saint Louis University School of Medicine	Uniformed Services University of the Health Sciences F. Edward Hébert School of Medicine
Stanford University School of Medicine	Note: Prehealth advisors from Colgate University, the University of Hawaii, and Meredith College are also members of the MCAT Validity Committee.
The Ohio State University School of Medicine	
University of Texas Health Science Center at San Antonio Joe R. and Teresa Lozano Long School of Medicine	

The MVC is leading the evaluation of the validity, fairness, impact, and use of scores from the MCAT exam. The MCAT validity research addresses multiple goals:

- Provides evidence about the value of MCAT scores in admissions decisions and the comparability of scores for medical students from different backgrounds.
- Answers questions about the preparation, performance, and challenges faced by examinees from different backgrounds.
- Presents data to admissions officers that support their efforts to admit diverse classes of capable, caring students with the capacity to succeed and to contribute to the teaching and learning at their schools and to the practice of medicine.
- Uses findings about the needs of aspiring physicians from underrepresented backgrounds to improve test preparation resources and outreach efforts.

Described below are examples of the research being conducted to achieve these goals.

The MVC is exploring how well medical students' MCAT scores predict their academic performance at different stages of their undergraduate medical education. Data on how well MCAT scores predict students' performance across preclerkship courses and on the USMLE Step 1 exam are reported in this guide. In the future, the MVC will conduct research on the validity of MCAT total and section scores and undergraduate GPAs in predicting performance in clerkships and on other USMLE Step exams and graduation within four or five years. The committee will also be evaluating the comparability of MCAT scores in predicting students' performance on these same outcomes.

Research on the use of MCAT scores in medical student selection will examine the types of validity data that are most useful to medical schools with different missions, curricula and student support, and applicant pool characteristics. This research will help admissions officers identify applicants with the preparation needed to do well at their medical schools. It will also inform the AAMC's development of resources, tools, and data to help admissions officers and their committees use MCAT scores in sound ways.

Finally, the research draws on quantitative and qualitative data from examinees and prehealth advisors to deepen the current understanding about the needs and challenges of examinees when they prepare for the MCAT exam. The MVC is closely studying differences in the preparation and performance of examinees from educationally or economically disadvantaged backgrounds when compared with their more advantaged peers. Currently, the MVC is piloting new questions about test preparation strategies and barriers on the Post-MCAT Questionnaire. The responses may reveal differences in the ways that examinees from different backgrounds prepare that could inform the types of resources and outreach they need from the AAMC and the types of guidance they need from the prehealth advising and undergraduate faculty communities.

This research may reveal better ways to increase access to affordable resources that will support all examinees, but especially those from lower socioeconomic backgrounds and who attend less-resourced undergraduate institutions.

This summer, *Academic Medicine* will publish a collection of articles summarizing the MVC's research so far. These articles will describe how well MCAT scores predict students' performance in the first year of medical school,[22] how examinees prepare for and perform on the exam,[23] how admissions committees can admit more diverse classes by considering applicants with a wider range of MCAT scores,[24] and how to help students strategically prepare for the exam.[25] Visit academicmedicine.org to read the articles. New findings from the MCAT validity research will be made available each year in this guide, at national and regional meetings, and at aamc.org/admissions. Questions about the research may be sent to mcatvalidty@aamc.org.

Association of
American Medical Colleges
655 K Street, NW, Suite 100, Washington, DC 20001-2399
T 202 828 0400
aamc.org

19-070B (06/19)