Predicting Medical Student Performance

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Working group on predicting medical student performance

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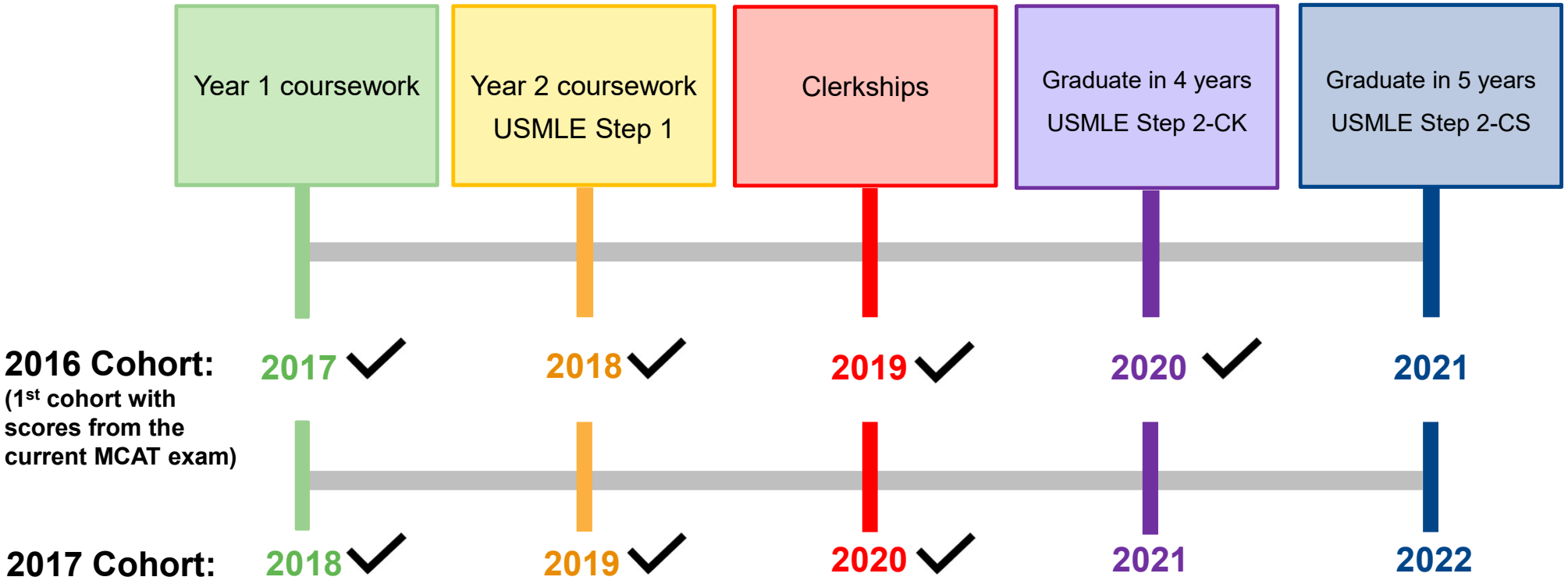
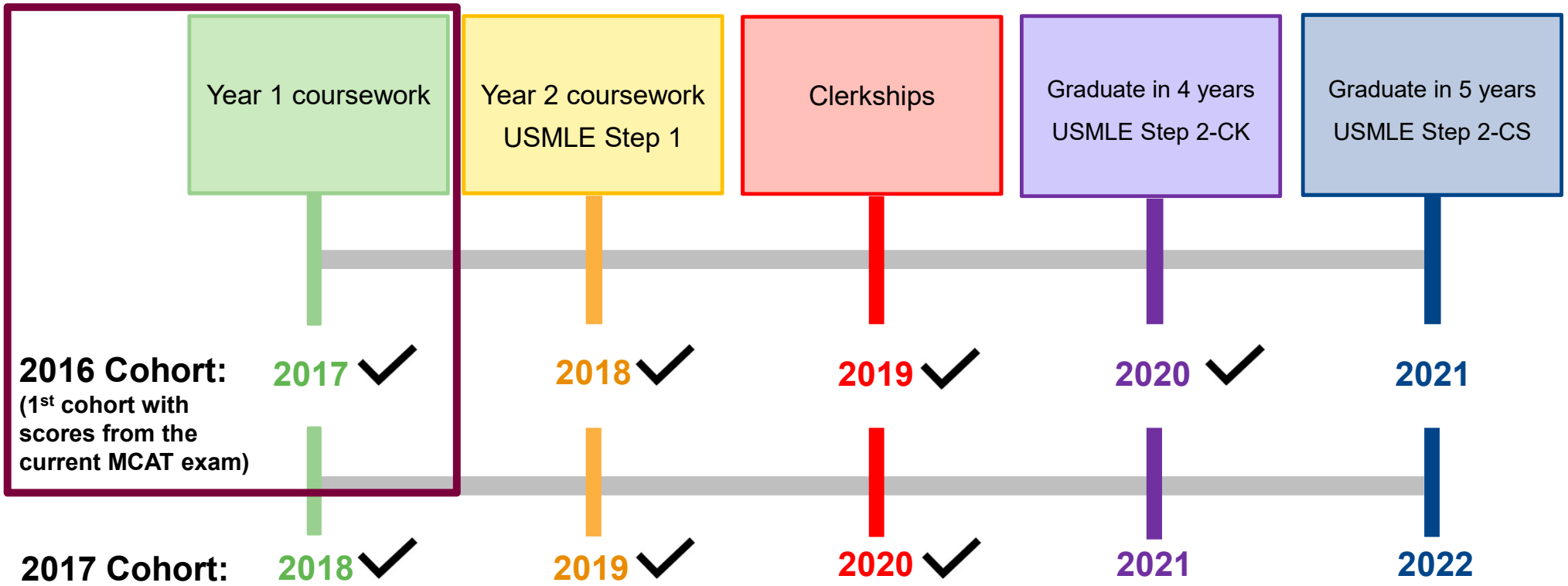
Agenda

- Discuss the draft manuscript outline on the validity of MCAT scores and undergraduate GPAs in predicting preclerkship, clerkship, USMLE Step 1 and Step 2 CK performance, and successful completion of milestones in medical school
- Discuss next steps and timeline to develop and submit the manuscript

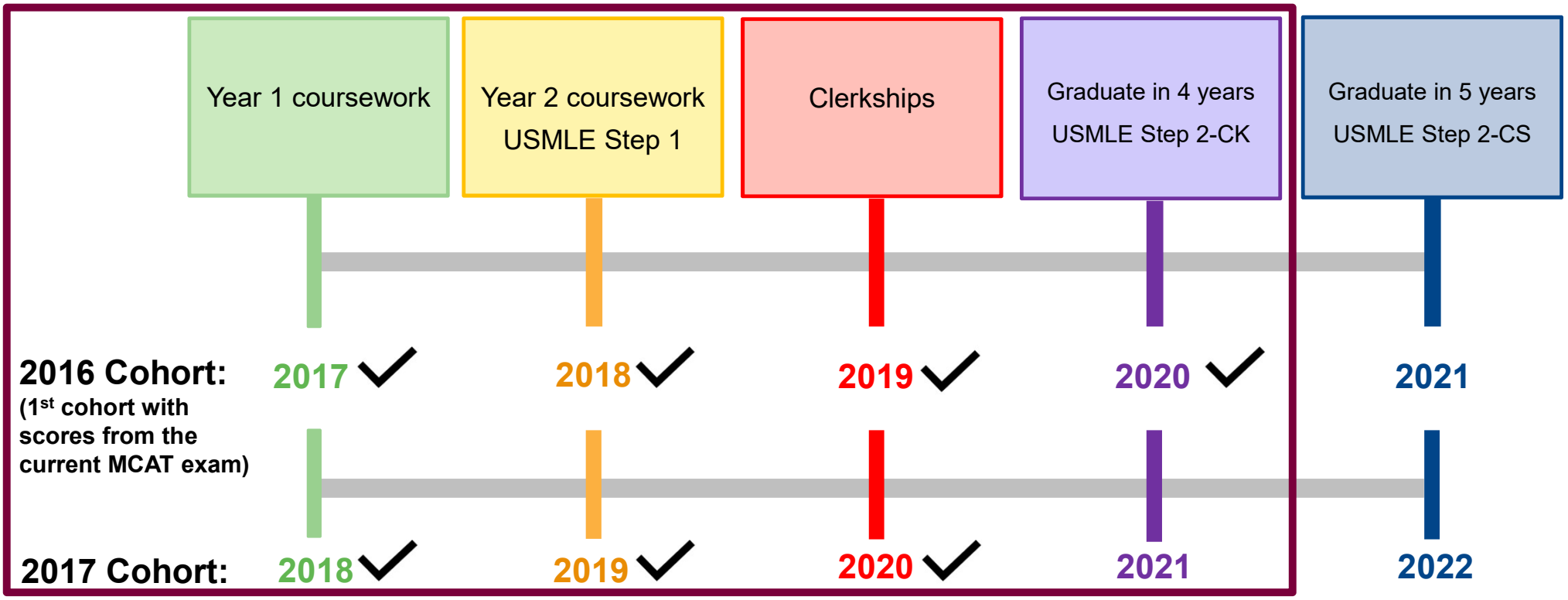
Preclerkship, clerkship, and USMLE Step 1 and Step 2 CK outcome data for the 2016 & 2017 cohorts and graduation in 4 years for the 2016 cohort are available for analysis



The first research report published findings about the validity of MCAT scores and UGPAs in predicting Year 1 coursework and progression to Year 2 based on the 2016 cohort's data



The next manuscript presents the validity of MCAT scores in predicting preclerkship, clerkship, USMLE Step 1 and Step 2 CK performance and completion of UME milestones for two cohorts



This manuscript addresses three research questions

1. Do MCAT total scores add value beyond UGPAs in predicting students' preclerkship, Step 1, clerkship, and Step 2 CK performance?
2. Do MCAT total scores add value beyond UGPAs in predicting students' likelihood of successfully completing UME milestones?
3. Do MCAT scores provide comparable prediction of students' preclerkship and clerkship performance, and successful completion of UME milestones for students from different sociodemographic backgrounds?

Participants include two cohorts of medical school entrants

- Validity sample
  - About 2,800 students from the validity schools who entered medical school in 2016 and 2017 with scores from the current MCAT exam
  - 15 schools in the US and 2 schools in Canada
- US population of 2016 and 2017 medical school entrants
  - About 26,000 students who entered US MD-degree granting medical schools in 2016 and 2017 with scores from the current MCAT exam

All individuals included in this research applied with scores from the current MCAT exam

This manuscript used two predictors and six outcomes

- Two predictors:
  - UGPA
  - MCAT total scores
- Six outcomes

Performance Outcome	Definition	Sample
Performance across preclerkship courses	Validity schools identified preclerkship courses that have reliable performance measures. Preclerkship performance is defined and computed as the mean performance across these courses.	2016 + 2017 validity school participants who applied with scores from the current MCAT exam
Step 1 score from the first attempt	Score from the first attempt on Step 1	2016 + 2017 US MD-granting medical school entrants who applied with scores from the current MCAT exam
Clerkship exam scores	The mean score across NBME clinical science subject exam scores associated with clerkships that validity schools identified as core clerkships with reliable performance measures	2016 + 2017 validity school participants who applied with scores from the current MCAT exam
Clerkship GPAs	The mean of final metrics (e.g., ratings, letter grades, and numeric scores) across clerkships that validity schools identified as core clerkships with reliable performance measures	2016 + 2017 validity school participants who applied with scores from the current MCAT exam
Step 2 CK score from the first attempt	Score from the first attempt on Step 2 CK	2016 + 2017 US MD-granting medical school entrants who applied with scores from the current MCAT exam
Successful completion of UME milestones	Yes = students who did not withdraw or take leave of absence or were not dismissed for academic reasons, *AND* completing M3 on time or with 1 extra year, *AND* pass Step 1 and Step 2 CK on the first attempt No = students who withdrew or took leave of absence, or were dismissed for academic reasons, *OR* failed to complete M3 on time or with 1 extra year, *OR* failed to pass Step 1 or Step 2 CK on the first attempt	2016 + 2017 US MD-granting medical school entrants who applied with scores from the current MCAT exam

Discuss whether to include graduation in 4 years in the outcome of successful completion of UME milestones

- We want to include both the 2016 and 2017 cohorts to maximize the representativeness of participants
- Timeline of when graduation data become available for each cohort

	December 2020	December 2021	December 2022
2016	Graduation in 4 years	Graduation in 5 years	
2017		Graduation in 4 years	Graduation in 5 years

	Pro	Con
Excluding graduation in 4 years	Allow us to move faster on the publication of this report (i.e., submitting the manuscript in spring/summer of 2021)	Miss an important UME milestone
Including graduation in 4 years	Be able to provide evidence about the validity of MCAT scores in predicting graduation	May delay the submission and acceptance of the manuscript

Q1. Do MCAT total scores add values beyond UGPAs in predicting students' preclerkship, Step 1, clerkship, and Step 2 CK performance?

Five outcomes were used to answer the first research question

- Predictors: MCAT total scores and UGPA

Outcome	Validity Sample Only	US Population
Preclerkship performance	Yes	/
Clerkship exam scores	Yes	/
Clerkship GPAs	Yes	/
Step 1 score from the first attempt	/	Yes
Step 2 CK score from the first attempt	/	Yes

Three sets of linear regression analyses were conducted on each outcome by school

- This replicates the analytic method used in the first publication
- Regression analysis by school (for each outcome)
  - Model 1: UGPA as the only predictor
  - Model 2: MCAT total score as the only predictor
  - Model 3: Both UGPA and MCAT total score as predictors
- Raw correlation coefficient between predictor(s) and each outcome corrected for range restriction in UGPA and MCAT total scores
- The median of corrected correlation coefficients across schools was used to summarize the results for each outcome

Results showed a consistent pattern that MCAT scores provide better prediction of medical student outcomes than UGPAs and using both metrics predict better than either predictor alone

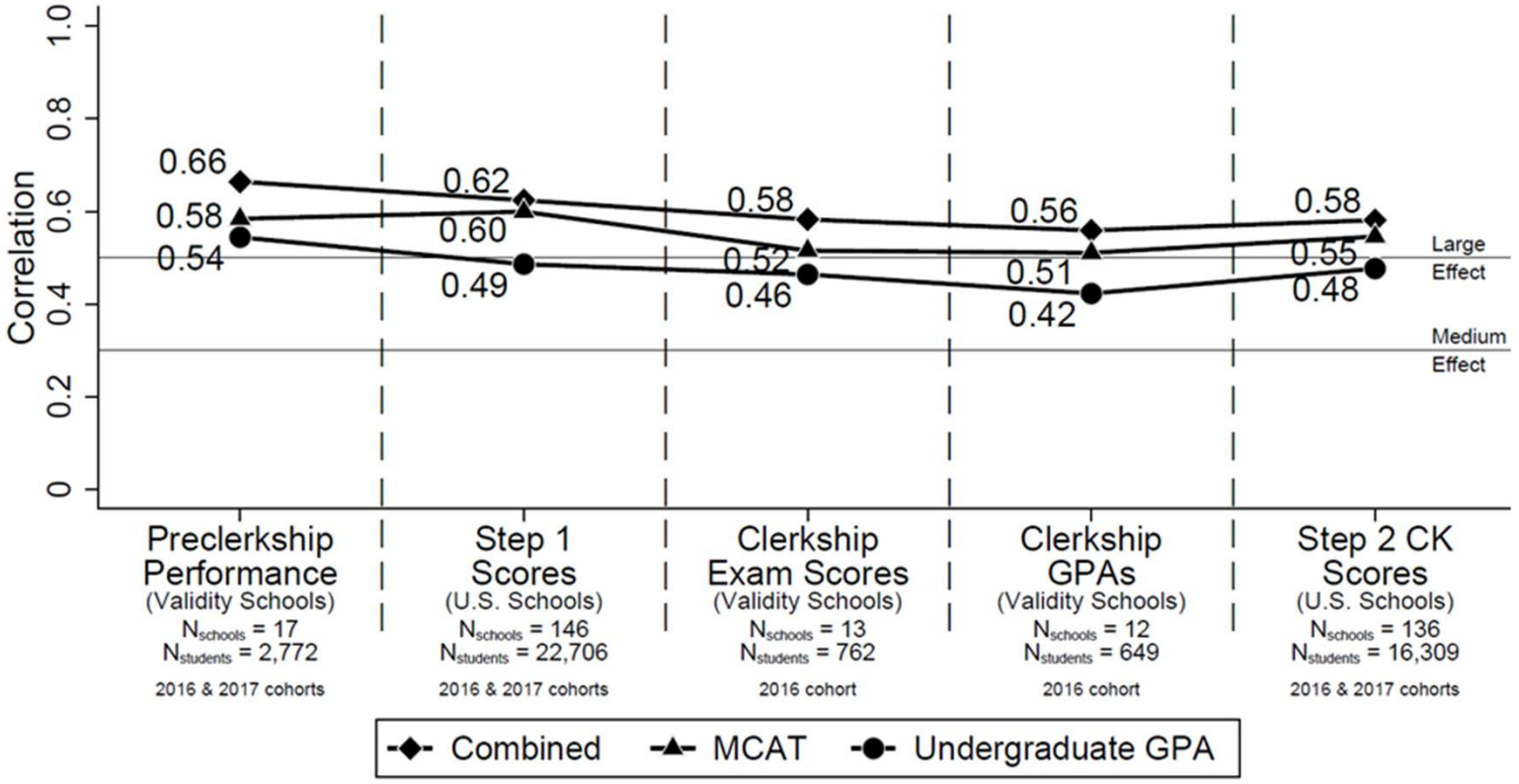


Figure 1. Correlations of 2016 and 2017 medical school matriculants' MCAT total scores and UGPAs, alone and together, with students' preclerkship and clerkship performance, and Step 1 and Step 2 CK scores

Current MCAT scores predict medical student performance slightly better than old MCAT scores; and the validities of current MCAT scores compare well to those for other admissions tests

Author (Year)	Exam	Type of Exam Score	Type of Outcome	Median Validity Coefficient	Unit of Analysis
MVC (2016 & 2017 cohort)	Current MCAT	Total score	Performance across preclerkship courses	.58	School (N_{school}=17)
MVC (2015 cohort)	Old MCAT	Total score	Performance across preclerkship courses	.54	School (N_{school}=17)
MVC (2016 & 2017 cohort)	Current MCAT	Total score	Clerkship exam scores Clerkship GPAs	.52 .51	School (N_{school}=13) School (N_{school}=12)
MVC (2015 cohort)	Old MCAT	Total score	Clerkship exam scores Clerkship GPAs	.47 .37	School (N_{school}=12) School (N_{school}=10)
MVC (2016 & 2017 cohort)	Current MCAT	Total score	Step 1 total scores Step 2 CK total scores	.60 .55	School (N_{school}=146) School (N_{school}=136)
MVC (2015 cohort)	Old MCAT	Total score	Step 1 total scores Step 2 CK total scores	.57 .48	School (N_{school}=140) School (N_{school}=141)
Talento-Miller & Rudner (2005)	GMAT	Total score	Mid-program grades	.47	Study (N_{study} = 272)
Law School Admission Council (2020)	LSAT	Total score	First-year performance	.61	School (N_{school}=173)

Reference:
1. LSAC (2020) Summary of 2017, 2018, and 2019 LSAT correlation study results. Retrieved from https://www.lsac.org/system/files/inline-files/lsat-correlation-results_combined_2017_2018_2019_0.pdf
2. Talento-Miller, E. & Rudner, L. M. (2005). GMAT validity study summary report for 1997 to 2004. Retrieved from https://www.gmac.com/-/media/files/gmac/research/validity-and-testing/rr0506_vsssummaryreport.pdf

Q2. Do MCAT total scores add values beyond UGPAs in predicting students' likelihood of successfully completing UME milestones?

The second research question focuses on successful completion of UME milestones

- Predictors: MCAT total score and UGPA
- Outcome: Successful completion of UME milestones

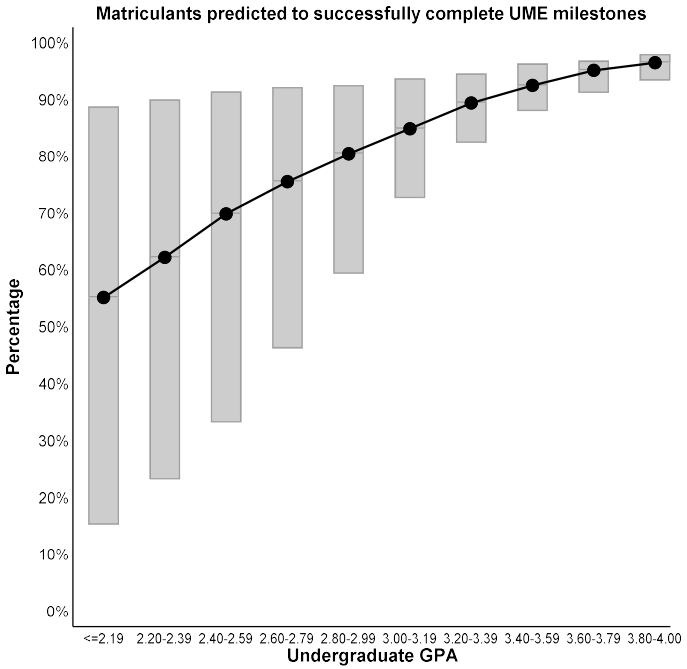
Yes	No
Had no academic difficulty in UME	Had academic difficulty in UME
AND	OR
Completed M3 on time or with 1 extra year	Failed to complete M3 on time or with 1 extra year
AND	OR
Passed Step 1 and Step 2 CK on the first attempt	Failed to pass Step 1 or Step 2 CK on the first attempt

Note: Students who withdrew, took leave of absence, or were dismissed due to academic reasons were considered as having academic difficulty.

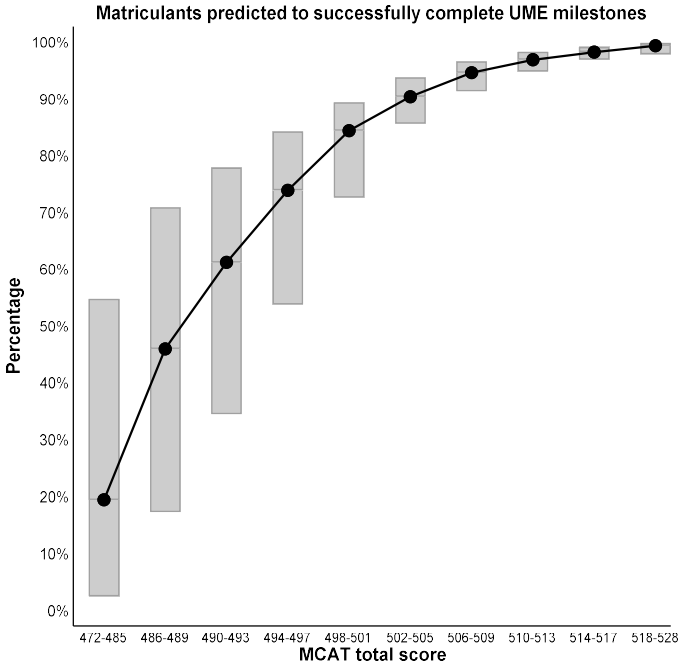
Logistic regression was used to examine the validity of UGPA and MCAT total scores in predicting the likelihood of successfully completing UME milestones

- Conducted logistic regressions by school
  - Model 1: UGPA as the only predictor
  - Model 2: MCAT total score as the only predictor
  - Model 3: Both UGPA and MCAT total score as predictors
- Computed the predicted likelihood of successfully completing UME milestones for UGPA values from 2.0 to 4 at 0.1 increments (e.g., 3.0, 3.1, 3.2) and each MCAT total score point (e.g., 500, 501, 502)
- Summarized results across schools by presenting the median and interquartile range of the likelihood of successfully completing UME milestones for matriculants by UGPA and MCAT total score range

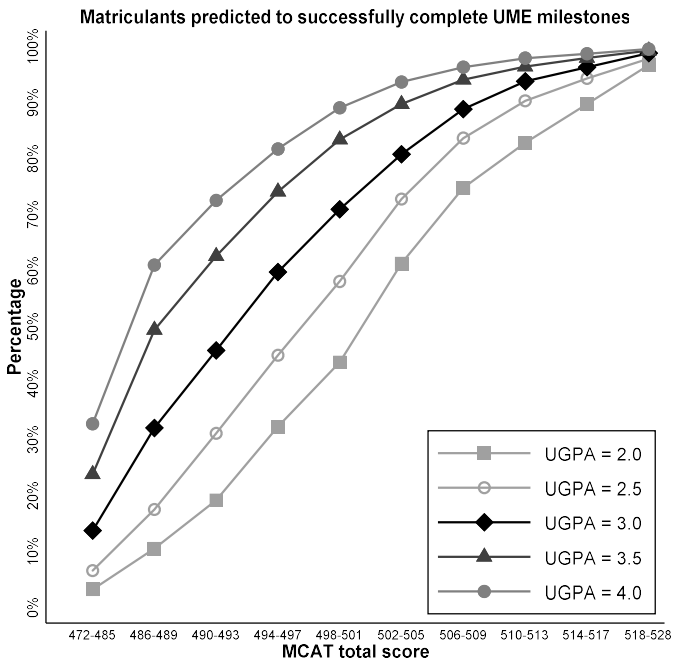
Higher MCAT scores and UGPAs are associated with greater likelihood of successfully completing UME milestones



2a. Median and IQR of predicted percentage of matriculants who successfully complete UME milestones by UGPAs



2b. Median and IQR of predicted percentage of matriculants who successfully completed UME milestones by MCAT total scores



2c. Predicted percentage of matriculants who successfully completed UME milestones by UGPAs and MCAT total scores

Q3. Do MCAT scores provide comparable prediction of students' preclerkship and clerkship performance, and successful completion of UME milestones for students from different sociodemographic backgrounds?

Three grouping variables and all six outcomes were used to address research question 3

- Three grouping variables
  - URM vs Not URM
  - Low SES vs high SES
  - Female vs Male

Performance Outcome	Definition	Sample
Performance across preclerkship courses	Validity schools identified preclerkship courses that have reliable performance measures. Preclerkship performance is defined and computed as the mean performance across these courses.	2016 + 2017 validity school participants who applied with scores from the current MCAT exam
Step 1 score from the first attempt	Score from the first attempt on Step 1	2016 + 2017 US MD-granting medical school entrants who applied with scores from the current MCAT exam
Clerkship exam scores	The mean score across NBME clinical science subject exam scores associated with clerkships that validity schools identified as core clerkships with reliable performance measures	2016 + 2017 validity school participants who applied with scores from the current MCAT exam
Clerkship GPAs	The mean of final metrics (e.g., ratings, letter grades, and numeric scores) across clerkships that validity schools identified as core clerkships with reliable performance measures	2016 + 2017 validity school participants who applied with scores from the current MCAT exam
Step 2 CK score from the first attempt	Score from the first attempt on Step 2 CK	2016 + 2017 US MD-granting medical school entrants who applied with scores from the current MCAT exam
Successful completion of UME milestones	Yes = students who did not withdraw or take leave of absence or were not dismissed for academic reasons, *AND* completing M3 on time or with 1 extra year, *AND* pass Step 1 and Step 2 CK on the first attempt No = students who withdrew or took leave of absence, or were dismissed for academic reasons, *OR* failed to complete M3 on time or with 1 extra year, *OR* failed to pass Step 1 or Step 2 CK on the first attempt	2016 + 2017 US MD-granting medical school entrants who applied with scores from the current MCAT exam

We used the same analytic method as in the first publication to examine whether MCAT scores provide comparable prediction by student background characteristic

- Step 1: Conducted linear and logistic regression analyses within school
  - MCAT score was regressed on the outcome
- Step 2: Generated predicted outcome and prediction error for each individual
- Step 3: Computed the average observed and predicted outcomes separately for all students included in a sociodemographic group

Outcome	Sociodemographic Variable	Student Groups	Number of Students	Observed outcome		Predicted outcome		Difference	Effect Size
				Mean	S.D.	Mean	S.D.		
Performance across preclerkship courses	Students' Racial /Ethnic Identity	Not URM	1,678	86.21	5.43	85.95	3.26	0.26	0.06
		URM	659	82.93	6.66	83.61	3.45	-0.68	-0.13

We used the same analytic method as in the first publication to examine whether MCAT scores provide comparable prediction by student background characteristic

- Step 3: Computed the average observed and predicted outcomes separately for all students included in a sociodemographic group
- Step 4: Tested whether the mean residual (i.e., the difference between the average observed and predicted outcomes) differed from zero
- Step 5: Computed the effect size associated with each mean residual to estimate the magnitude of prediction error

Outcome	Sociodemographic Variable	Student Groups	Number of Students	Observed outcome		Predicted outcome		Difference	Effect Size
				Mean	S.D.	Mean	S.D.		
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		URM	659	82.93	6.66	83.61	3.45	-0.68	-0.13

Results showed that MCAT scores provided comparable prediction of preclerkship, clerkship, Step 1 and Step 2 CK performance, and successful completion of UME milestones for students from different backgrounds

- The size of prediction error was less than small for all analyses
  - These effect sizes are measures of the magnitude of prediction error
  - An effect size of 0.2 is considered small
  - Prediction error with an effect size less than 0.2 means the difference between the average observed and predicted outcomes is trivial and of no practical importance

Figures 1 & 2 and Tables 2 & 3 in the manuscript outline will be updated with more clerkship, Step 1, Step 2 CK, and academic records data before the submission

Importance and Limitations

This research is important to the medical education community as it provides the most comprehensive evidence about the validity of current MCAT scores to medical school admissions committees

- Participants come from US and Canadian medical schools
- Large number (N ≈ 26,000) of participants who represent north America MD students and medical schools well
- The report provides validity of MCAT scores in predicting key outcomes throughout undergraduate medical education
- The report provides validity evidence based on both local outcomes developed by school and national outcomes (e.g., licensure, graduation) that are common to all schools

What is missing about the value of the manuscript?

Limitations of this research

- Graduation in 5 years is not available for analysis
  - Next manuscript could examine the validity of MCAT scores in predicting graduation on time
- Limited to MD students only
  - Work with the AACOM to study the validity of MCAT scores in predicting performance of DO students is underway
- Lack of high-quality measures that capture aspects of performance that are important for being a good doctor, such as teamwork, professionalism, and interaction with patients
  - Future outcomes such as Step 2 CS may provide data on these aspects of performance

What is missing about the limitations of the manuscript?

Next Steps and Tentative Timeline to Develop and Submit the Manuscript

Tentative timeline to develop and submit the manuscript

	Jan	Feb	Mar	Apr	May	Jun	Jul
Josh and Kun write the 1st draft manuscript	X	X					
You are invited to review and revise the 1st draft manuscript			X				
Josh and Kun revise the manuscript based on your feedback				X			
You are invited to review and revise the 2nd draft manuscript					X		
Josh and Kun finalize and submit the manuscript						X	X

Report out to the MVC

- ❑ Objectives
- ❑ Discussion summary
- ❑ Feedback desired from the MVC about future research ideas
- ❑ Next steps

Future research topics proposed by the MVC in March

- How well do MCAT scores predict the likelihood to graduate on time?
- How well do section scores predict medical student outcomes?
- How does the validity of MCAT scores vary by school characteristics such as missions, curriculum, and student support?
- How does the validity of MCAT scores vary by student background characteristics?
- How well do students with discrepant undergraduate GPAs and MCAT scores do in school?

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