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Viewpoint

There has been consistent interest in bolstering the physician-scientist workforce to fuel discovery and translational research (1, 2). In 2014, the Physician-Scientist Workforce Working Group assembled by the NIH identified increasing diversity of the physician-scientist workforce as a priority for the future advancement of the profession; at the time, almost three-quarters of NIH research project grant recipients with an MD-PhD were White, and greater than two-thirds were male (3, 4). Even so, women and underrepresented minorities (URMs), which include Black/African Americans, Hispanics/Latinos, and Native Americans/American Indians, remain underrepresented. The enrollment data for 2018–2019 show that women made up 39.9% of matriculated MD-PhD students, up from 37.7% in 2014–2015 (5). In the past five years, the rate for women enrolled has increased at about 0.55% per year. Even if growth continued at the 2018–2019 rate (1.1%), it would take another ten years for parity to be reached between men and women enrolled in MD-PhD programs. Similar trends emerge for URM MD-PhD students: the graduating class of 2018 had 13.8% URM graduates, whereas 2018–2019 matriculants included 12.1% URMs (6, 7). For that academic year, 16% of applicants were URMs (8). These data highlight that there has been almost no growth in the number of URM MD-PhD students matriculating compared with those who matriculated 8–10 years prior (i.e., graduating class of 2018). Additionally, [...]

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There has been consistent interest in bolstering the physician-scientist workforce to fuel discovery and translational research (1, 2). In 2014, the Physician-Scientist Workforce Working Group assembled by the NIH identified increasing diversity of the physician-scientist workforce as a priority for the future advancement of the profession; at the time, almost three-quarters of NIH research project grant recipients with an MD-PhD were White, and greater than two-thirds were male (3, 4). Even so, women and underrepresented minorities (URMs), which include Black/African Americans, Hispanics/Latinos, and Native Americans/American Indians, remain underrepresented. The enrollment data for 2018–2019 show that women made up 39.9% of matriculated MD-PhD students, up from 37.7% in 2014–2015 (5). In the past five years, the rate for women enrolled has increased at about 0.55% per year. Even if growth continued at the 2018–2019 rate (1.1%), it would take another ten years for parity to be reached between men and women enrolled in MD-PhD programs.

Similar trends emerge for URM MD-PhD students: the graduating class of 2018 had 13.8% URM graduates, whereas 2018–2019 matriculants included 12.1% URMs (6, 7). For that academic year, 16% of applicants were URMs (8). These data highlight that there has been almost no growth in the number of URM MD-PhD students matriculating compared with those who matriculated 8–10 years prior (i.e., graduating class of 2018). Additionally, it is necessary to examine reasons why potential women and URM applicants decide not to apply to MD-PhD programs from the outset.

The story admissions statistics tell

Potential applicants spend considerable time on the internet looking for information about individual MD-PhD programs. A study focused on minority students who applied to medical school revealed that “[t]he few [participants] who searched school websites for information about the admissions process reported that the quality of the websites mattered, being critical resources for students with no other access to information” (9). Although the study population focused on medical students, this suggests that providing accurate and clear data on websites could be a way of raising awareness about programs for women and URM applicants with no other source of reliable information about applying, such as a mentor, family member, or pre-health advisor. URM premedical students cite lack of mentorship and advising as a barrier to applying to medical school, with some receiving information when they felt it was too late, leaving them at a disadvantage (10). Data on premedical women college students show that they are more likely than male undergraduates to view premedical course grades as a barrier to medical school admission (11). Thus, potential applicants look online for details to inform whether or not they should apply in order to maximize their chances relative to the upfront costs of applying.

Applicants have access to the Medical School Admissions Requirements database if they purchase it through the Association of American Medical Colleges (AAMC), which compiles statistics such as grade point average (GPA) and Medical College Admission Test (MCAT) scores that are useful for those creating a list of schools to which to apply. Howev-

er, these data are not as useful for those applying to MD-PhD programs, who have a slightly different application process. For MD-PhD applicants, quantity and quality of research experience often play into the admissions decision, but this is difficult to compare across applicants, since many (29.7%) who end up matriculating in programs have at least one year of prior research (12). Therefore, potential applicants may try to use metrics that can be compared among applicants, such as MCAT score or GPA, to guide their application process. Some potential applicants might even turn to anonymous online forums such as Student Doctor Network and Reddit, where they can scroll through posts to gauge their chances of being considered for, and accepted into, an MD-PhD program. The self-selection bias of those who post on these sites may paint an unbalanced picture of who is applying, and the advice provided is given by anyone on the internet, whether or not they are familiar with the admissions procedures at different programs. Furthermore, postings represent the perception of just one person using a pseudonym, so their reliability cannot be confirmed.

Some potential applicants may come across statistics published by the AAMC that show the mean, minimum, and maximum GPA and MCAT scores for MD-PhD matriculants. For 2018 matriculants the mean GPA was 3.79 ± 0.19 with a range of 2.68–4.00, and the mean MCAT score was 515.6 ± 5.6 with a range of 497–528 (13). These data can be both intimidating and comforting. The data are intimidating if one considers the means and standard deviations, which suggest a distribution with a very negative skew, with 50 percent of matriculants earning an MCAT score above the 92nd percentile or having a GPA greater than 3.8. However, the data might be comforting to some because the minimum GPA and MCAT composite score of

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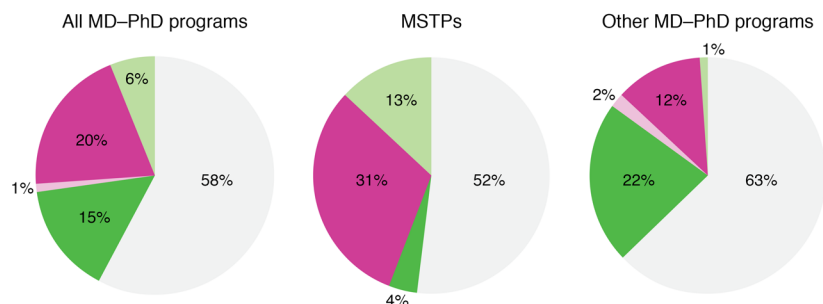
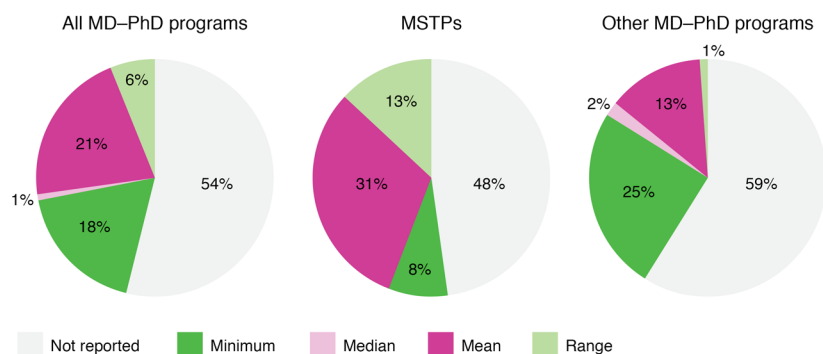
A MCAT score reported**B** Grade point average reported

Figure 1. Categories of admissions statistics reported by MD-PhD programs on their websites. (A) MCAT exam scores. **(B)** Grade point averages. Pie charts represent the data for all MD-PhD programs (left), Medical Scientist Training Programs (MSTPs; middle), and other MD-PhD programs (right). The colors represent the categories of admissions statistics (minimum, median, mean, range, and no statistics reported) presented on the websites.

matriculants are 2.75 and 495.0, respectively. It should also be noted that a study of MD-PhD enrollees who took the MCAT in the early 2000s showed that 92.1% of applicants had an MCAT score in the upper two quintiles, which may be daunting to those with lower scores (14). The fact that this information can be both intimidating and comforting simply adds to the uncertainty of potential applicants trying to determine whether they are competitive.

The MCAT and GPA data on interviewees, accepted applicants, and matriculants provided by MD-PhD programs vary drastically. Searching the internet in late June 2019, we identified that 116 of 121 MD-PhD programs had a website with specific admissions-related details. More than 50 percent of programs included no information regarding MCAT score or GPA for individuals who applied to, interviewed at, were accepted to, or matriculated into their program (Figure 1). One-fifth of program websites listed a mean MCAT score and GPA; the majority did not

include a standard deviation, making the mean difficult to interpret. Less than ten percent of programs included a range for these statistics on their website, although NIH-funded Medical Scientist Training Programs were more likely than other MD-PhD programs to include a range (13% vs. 1%, respectively).

These data points are used by potential applicants as critical information when deciding whether and where to apply. Therefore, these data can serve to encourage more potential applicants to submit applications because they may feel more qualified, or they can be a deterrent, depending on how they are presented. Similarly, information (e.g., means without standard deviations) suggesting that only those with high scores are accepted into a program may contribute to self-selection by women and URM applicants out of the application process due to fear of not being sufficiently qualified. The lack of accurate information may be feeding into imposter syndrome for women and URM applicants

and thus acting as a deterrent. Interestingly, women are more likely to apply to lower-ranking MD-PhD programs, again suggesting that some applicants may be applying depending on the programs for which they believe they are qualified (15).

Imposter syndrome

Students battling impostor syndrome feel they are not smart or talented enough to pursue this profession (16). Furthermore, they live in constant fear that they will be exposed as a fraud and asked to leave their program. This perception is internalized and over time eats away at their self-confidence. The fear, when exacerbated, can result in anxiety, stress, or depression (17). Imposter syndrome is manifested by comparing oneself to others, not feeling academically prepared and on par with peers, and questioning the validity of one's acceptance into a program (18, 19).

The literature about the experience of premedical students, especially women and minorities, is currently limited. However, there is evidence for increased attrition of these groups in premedical required courses and STEM majors due to seeing grades and GPA as a marker of competency or fit for the career path (11, 20, 21). The fear associated with imposter syndrome may cause individuals not to apply if they do not feel they are the perfect applicant with average or above-average MCAT scores and GPA. Lack of knowledge as to the full ranges of these scores does little to alleviate their concerns.

Redefining the ideal MD-PhD candidate

Having clear and accessible information on successful applicants to individual programs would be a simple step toward improving equity in the MD-PhD application process. Publishing the range of MCAT scores and GPAs of those that a program has accepted, perhaps over a range of time such as ten years, would allow those considering applying to make informed decisions about their candidacy. In this way, women and URM applicants who may have been deterred by lack of information or misleading high-mean statistics for many programs would instead have sufficient information that might make them more likely to apply. Pooling the data for accepted students over a certain period

of time would ensure that this range would not identify individuals who matriculate at smaller programs or specific individuals in a matriculating class. Above all, this strategy would be a simple step toward redefining the manufactured image of academic perfection (i.e., high GPA and MCAT score with many publications) that many believe represents those who will be successful applicants and future physician-scientists.

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