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Characteristics of medical-school matriculants who participated in postbaccalaureate-premedical programs

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Abstract

Background—The authors sought to identify factors associated with U.S. medical-school matriculants' postbaccalaureate-premedical-program participation and to determine if participation was associated with plans at medical-school graduation to practice in underserved areas.

Method—Using multivariable logistic regression, de-identified, individualized records of Medical College Admission Test (MCAT) scores and AAMC Matriculating Student Questionnaire responses for the 1996-2000 national cohort of U.S. medical-school matriculants were analyzed for associations with postbaccalaureate-premedical-program participation; postbaccalaureate-premedical-program participation was analyzed for associations with graduates' plans to practice in underserved areas, based on AAMC Graduation Questionnaire responses. Adjusted odds ratios (ORs) significant at $P < .05$ are reported for independent predictors of postbaccalaureate-program participation among matriculants and of graduates' plans to practice in underserved areas.

Results—The study sample of 57,276 matriculants included 3,561 (6.2%) academic-record-enhancer-program, 3,931 (6.9%) career-changer-program, and 1,354 (2.4%) career-changer/academic-record-enhancer-program participants. Matriculants with lower MCAT scores (<18 : OR=6.16; 18-20: OR=4.26; 21-23: OR=3.22; 24-26: OR=2.30; 27-29: OR=1.76, each vs. MCAT >29), who participated in college summer academic-enrichment programs (OR=1.35), had premedical debt (OR=1.25) and were underrepresented minority race/ethnicity (OR=1.21) were more likely to report academic-record-enhancer-program participation. Students who decided after college to study medicine (OR=15.94) and women (OR=1.46) were more likely to report career-changer-program participation. Compared to non-participants, each of academic-record-enhancer, career-changer, and academic-record-enhancer/career-changer program participants were more

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likely to plan, at medical-school graduation, to practice in underserved areas (OR = 1.14; 1.48 and 1.47, respectively).

Conclusions—Among medical-school matriculants, postbaccalaureate-premedical-program participants were demographically diverse and were more likely than non-participants to plan to practice in underserved areas.

Introduction

Postbaccalaureate-premedical programs, in existence for over 30 years,¹⁻⁴ are offered at institutions throughout the U.S. and serve a range of student needs. Programs may be designed for individuals who want to change careers but have not completed premedical-course requirements or for individuals who want to improve their academic records to make their medical-school applications more competitive. Programs also may aim specifically to support students from groups currently underrepresented in medicine or from educationally or economically disadvantaged backgrounds in their pursuit of a career in medicine.⁵ Despite the long-standing nature of many of these programs, information about postbaccalaureate-program participants who subsequently enrolled in medical school is limited. Several reports have described non-degree-granting, academic-enrichment programs, typically of about one year's duration, that included a particular focus on college graduates from groups historically underrepresented in medicine and/or from economically or educationally disadvantaged backgrounds.^{1, 2, 6-10} These programs varied considerably in selection criteria for participation, curricular design, and the extent of conditional medical-school acceptance arrangements in place for participants who completed their programs. Despite these differences, many students who successfully completed these postbaccalaureate academic-enrichment programs subsequently continued their education in a range of health professions schools and programs, including Liaison Committee on Medical Education (LCME)-accredited medical schools, U.S. osteopathic medical schools, Masters' programs in science and allied health professions and medical schools outside the U.S.^{2, 6-10} One study reported that 91% of their program participants who matriculated in medical school in 2000 and 2001 had graduated by 2005.¹⁰ Another single-institutional study reported that 63% of their postbaccalaureate-program-participants who subsequently enrolled in medical school had graduated from medical school in four years, 18% had graduated in five years, and 19% had graduated in six or more years.⁸

Recent information regarding career-changer-program participants' success in gaining entry to medical school is largely limited to program website descriptions indicating that, at least for some long-standing career-changer programs, participants who applied to medical school had high degrees of success in gaining acceptance to medical school, "up to or in excess of 90%."^{3, 4} Published literature included one older, single-school descriptive study about career-changer-program participants' progress in medical school.¹¹

In 2008, the LCME adopted the revised MS-8 standard which states that, "Each medical school must develop programs or partnerships aimed at broadening diversity among qualified applicants for medical school admission." In the annotation for this revised standard, the LCME cited "academic enrichment programs for applicants who may not have taken traditional pre-medical coursework" as among the approaches that medical schools might take to accomplish the revised standard aim of enhancing the accessibility of a medical education to students from diverse backgrounds.¹² As interest in postbaccalaureate-premedical programs may increase in the context of this newly adopted MS-8 revision, we sought to describe the characteristics of postbaccalaureate-program participants who matriculated in LCME-accredited medical schools and determine if postbaccalaureate-program participation was associated with career plans at medical-school graduation. We

hypothesized that the characteristics of matriculants who had participated in postbaccalaureate-premedical programs would differ from the characteristics of matriculants who had not participated in postbaccalaureate-premedical programs and that career intentions of postbaccalaureate-premedical-program participants would differ from the career intentions of non-participants at medical-school graduation. To test these hypotheses, we conducted a retrospective study of a national cohort of LCME-accredited medical-school matriculants.

Method

A database constructed for our analysis included individualized, de-identified records for all 1996-2000 matriculants enrolled in LCME-accredited U.S. medical schools with information from the Association of American Medical Colleges' (AAMC) Student Record System (SRS), the Matriculating Student Questionnaire (MSQ)¹³ and the Graduation Questionnaire (GQ).¹³ The MSQ and GQ are administered annually to incoming medical students and graduates, respectively, on a voluntary and confidential basis. The AAMC provided individualized, de-identified SRS records updated through March 2, 2009 for all 1996-2000 U.S. medical-school matriculants, including date of matriculation, sex (women vs. men), race/ethnicity (Asian/Pacific Islander; other/unknown, and underrepresented minorities in medicine [URM], including Black, Hispanic and American Indian/Alaska Native, vs. white), Carnegie Classification for undergraduate degree-granting institution, last status description for those matriculants who graduated or were no longer in medical school, and last-status date. From among 29 different Carnegie classifications of undergraduate degree-granting institutions, we created a six-category variable: 1) Baccalaureate Colleges-Arts & Sciences; 2) Research Universities – High Research Activity and Doctoral/Research Universities; 3) all Master's Colleges/Universities ; 4) all other Carnegie classifications of non-research-oriented undergraduate institutions (Other Institutions); 5) Carnegie classification Not specified; and 6) Research Universities – Very High Research Activity as the reference category.¹⁴ For matriculants who had graduated from medical school by March 2, 2009, medical-school duration was calculated as the number of years elapsed from matriculation date to graduation date. The AAMC provided matriculants' most-recent-attempt Medical College Admission Test (MCAT) results. A composite MCAT score was computed by totaling the verbal reasoning, physical science and biological science sub scores. The composite score was then categorized as: score not available, <18 , 19-21 , 22-24 , 25-27 and 27-29 vs. >29 (reference). We combined all composite MCAT scores <18 into a single category to ensure sufficient numbers of matriculants of all racial/ethnic groups in the lowest-score category, and we combined all composite MCAT scores >29 into a single reference group, because matriculants with MCAT scores >29 have been shown to be at a uniformly low likelihood of academic difficulty during medical school.¹⁵ (Fig. 3f, p. 916)

The AAMC provided responses to several selected MSQ items, including items about previous educational experiences and demographic characteristics, which we analyzed for this study. We identified matriculants who had participated in various programs during and after college, including Summer academic-enrichment program for college students, Laboratory research-apprenticeship program for college students, Non-degree postbaccalaureate program to strengthen academic skills, and Non-degree postbaccalaureate program to complete premedical requirements, based on responses to the MSQ item, "Did you participate in any of the following types of programs to prepare for professional schooling/career in medicine or related fields?" We created a four-category variable for postbaccalaureate-program participation based on students' responses (yes or no) to the two postbaccalaureate-program items: 1) academic-record-enhancer-program participation only to strengthen academic skills, 2) career-changer-program participation only to complete premedical requirements, 3) career-changer/academic-record-enhancer program

participation (for matriculants who reported participation in both program types), and 4) non-participation in either type of postbaccalaureate program. The initial year of matriculation for our study was 1996, because this was the first year that the MSQ included separate response choices for participation in each type of postbaccalaureate program. Because some postbaccalaureate-program participants who enrolled in medical school reportedly required more than four years to complete the medical-school curriculum,¹⁰ and one recent study noted that their medical-school enrollees (including postbaccalaureate-program participants and non-participants) were permitted up to eight years to complete the MD degree,⁸ the latest year of matriculation for our study was 2000, to allow a minimum follow-up period of eight years for all matriculants.

We also included MSQ variables for age at matriculation, premedical debt, parent occupation and the timing of a student's decision to study medicine. We analyzed premedical debt as a dichotomous variable (any premedical debt vs. no debt). From two MSQ items about mother's and father's occupation, we created a three-category variable for parent occupation (at least one parent is a physician, at least one parent is a professional but neither is a physician vs. all other parent occupations). From the seven response choices to the MSQ item, "When did you definitely decide that you wanted to study medicine?", we created a three-category variable: 1) before college (including before high school and during high school before college choices), and 2) after college (including after receiving bachelor's degree and after receiving advanced degree) and 3) during college (reference group, including during first two years of college, during junior year of college, and during senior year of college). Based on responses to the MSQ item, "Type of degree program in which you are enrolled," we included only MD-degree program matriculants for analysis, excluding matriculants in all other degree programs due to inherent differences in these programs' requirements.

Responses to two GQ items also were included in this analysis. The GQ item, "Do you plan to locate your practice in an underserved area?" (yes, undecided vs. no) was included as an outcome of interest. The predictive validity of this GQ item for the actual practice in underserved areas has been established.¹⁶ Based on graduates' responses to GQ items pertaining to their intended specialty and intent to sub-specialize in that specialty, we assigned graduates to one of eight specialty-choice categories for analysis: family medicine, obstetrics/gynecology, general internal medicine (including internal medicine/pediatrics), internal medicine subspecialties, general pediatrics, pediatrics subspecialties, no specialty chosen (GQ respondents who did not make a specialty choice) and all other specialties as the reference group.

Records for each student were linked using a unique, AAMC-generated identification number and merged into a single file for analysis. The Institutional Review Board at Washington University School of Medicine approved this study.

Statistical analysis

We used chi-square tests to measure associations among categorical variables and analysis of variance to describe differences in continuous variables between groups. We report adjusted odds ratios (OR) and 95% confidence intervals (CI) from two sets of separate multivariate logistic regression models. The first set of models identified independent predictors of postbaccalaureate-program participation (separate models for each of academic-record-enhancer, career-changer, and academic-record-enhancer/career-changer programs compared with the non-participant reference group). The second model identified independent predictors of graduates' plans to practice in underserved areas (separate models for graduates who said yes and undecided compared with graduates who said no). All tests

were performed using SPSS version 17.0.3 (SPSS, Inc., Chicago, IL, 2009). Two-sided P -values $<.05$ were considered significant.

Results

Our database included 80,851 individualized records of all 1996-2000 matriculants. Of these matriculants, 75,186 completed the MSQ at least in part. We excluded 4,708 MSQ respondents who were enrolled in MD/other degree programs, 585 MSQ respondents who did not answer the degree-program-at-enrollment item, and 12,617 MSQ respondents enrolled in MD-degree programs who were missing responses for one or more of the other MSQ items of interest for our study. Thus, our final study sample of 57,276 MD-degree program matriculants with complete data included 70.8% of all 1996-2000 matriculants.

Table 1 shows descriptive statistics for the study sample grouped by postbaccalaureate-program-participation category. The sample included 8,846 postbaccalaureate, non-degree premedical-program participants (15.4% of 57,276 MD-degree-program matriculants). The proportions of students reporting participation in each postbaccalaureate-program category fluctuated over the study period. Mean age (standard deviation [SD]) at matriculation was 25.0 (3.1) years for academic-record-enhancer-program participants, 27.7 (4.0) years for career-changer-program participants, 27.6 (4.0) years for career-changer/academic-record-enhancer-program participants, and 23.1 (2.5) years for non-participants ($P < .001$). Mean MCAT (SD) score was 27.5 (4.5) for academic-record-enhancer program participants, 28.9 (4.4) for academic-record-enhancer/career-changer program participants, 29.8 (4.2) for non-postbaccalaureate program participants and 30.5 (4.0) for career-changer-program participants ($P < .001$).

Table 2 shows results of the multivariable logistic regression models identifying variables associated with each of the three postbaccalaureate-program-participant categories compared with non-participation. The Hosmer and Lemeshow test indicated that each model was a good fit to the data (each $P > .05$). Matriculants who had definitely decided after college to study medicine or matriculants who had a physician parent were more likely to report postbaccalaureate-program participation and matriculants who received undergraduate degrees from Master's Colleges/Universities or Other institutions or had participated in a laboratory research-apprenticeship program during college were less likely to report postbaccalaureate-program participation. Findings for other variables included in the model differed somewhat among the three postbaccalaureate-program-participant groups. Undergraduate degree recipients from Baccalaureate Colleges-Arts & Sciences and women were more likely to report postbaccalaureate-career-changer-program participation, and students with progressively lower MCAT scores were increasingly more likely to report postbaccalaureate academic-record-enhancer-program participation or academic-record-enhancer/career-changer-program participation. URM matriculants and matriculants with premedical debt were more likely to report academic-record-enhancer-program participation compared with white matriculants and matriculants without premedical debt, respectively (each $P < .001$).

From the SRS data, we determined that 40 matriculants had died, and one matriculant had the medical degree revoked, leaving 57,235 matriculants with follow-up data. Of these matriculants, 96.9% (55,437/57,235) had graduated as of March 2, 2009, including 97.0% (46,956/48,400) of non-baccalaureate-program participants, 96.8% (3,800/3,924) of career-changer-program participants, 95.4% (3,393/3,557) of academic-record-enhancer-program participants, and 95.1% (1,288/1,354) of academic-record-enhancer/career-changer-program participants. Median medical-school duration was 4 years for the 54,701 graduates in the study sample with last-status date; 87.6% of the graduates in the non-participant group

completed medical school within four years, as did 85.5% of graduates in the career-changer-program participant group, 86.1% of graduates in the academic-record-enhancer-program participant group, and 84.5% of graduates in the academic-record-enhancer/career-changer-program participant group.

Of the 55,437 graduates in our study sample, 83.4% (46,208/55,437) had completed the GQ items of interest. Table 3 shows descriptive statistics for these GQ respondents, grouped by plans to practice in an underserved area. Table 4 shows results of the multivariable logistic regression models identifying variables associated with graduates' plans to practice in an underserved area, comparing graduates who said yes or undecided with graduates who said no. The Hosmer and Lemeshow test indicated that each model was a good fit to the data (each $P > .05$). Variables associated with a greater likelihood of planning to practice in an underserved area included more recent graduation year, female gender, URM race/ethnicity, participation in each type of postbaccalaureate program, not making a specialty choice, and choosing each of general internal medicine, general pediatrics, pediatrics subspecialties, family medicine and obstetrics and gynecology.

Discussion

Although most recent studies in the literature on postbaccalaureate-premedical programs pertained to academic-record-enhancer programs, our results indicated that more postbaccalaureate-program participants who subsequently enrolled in LCME-accredited medical schools had participated in career-changer, rather than academic-record-enhancer programs. Career-changer programs were predominant among the non-degree postbaccalaureate programs that provided information to the AAMC for inclusion on the AAMC Postbaccalaureate Premedical Programs website.⁵ Of 92 non-degree postbaccalaureate programs listed, there are 53 career-changer, 15 academic-record-enhancer, and 20 career-changer/academic-record-enhancer programs; four programs were neither career-changer nor academic-record-enhancer programs.⁵

All three postbaccalaureate-participant groups in our study shared some similarities, including that having a physician parent was associated with a greater likelihood of reporting participation in each of the three postbaccalaureate programs. We speculate that this observation might reflect, at least to some extent, a greater awareness among physician families of postbaccalaureate-premedical program opportunities.

We identified numerous differences between career-changer and academic-record-enhancer-program participants. Progressively lower MCAT scores were associated with increasingly greater likelihood of academic-record-enhancer-program and academic-record-enhancer/career-changer-program participation but not with career-changer-program participation. This observation is consistent with differences in program focus and with previous reports of academic-record-enhancer-program participants' MCAT scores.^{7, 9, 10} Women were more likely than men to have participated in career-changer programs, and URM students were more likely than white students to have participated in academic-record-enhancer programs, suggesting that increased matriculation of academic-record-enhancer program participants may have greater impact on the racial/ethnic diversity of medical-school enrollees than increased matriculation of career-changer-program participants. That participation in college-level summer enrichment programs to prepare for a career in science or medicine and that a student's decision to become a doctor before college were each associated with a greater likelihood of academic-record-enhancer-program participation suggests that academic-record-enhancer-program participants include a highly motivated student group with a long-standing commitment to their pursuit of medical careers. Despite lower MCAT

scores among academic-record-enhancer program participants in our study, their overall medical-school graduation rates were quite high.

Students with premedical debt were more likely to have participated in academic-record-enhancer programs, but not career-changer or career-changer/academic-record-enhancer programs. Because mean age at medical-school matriculation of academic-record-enhancer-program participants was only slightly higher than the mean age of non-participants, academic-record-enhancer-program participants likely participated in these programs immediately after college and, in doing so, may have accumulated pre-medical debt in order to continue their pursuit of a medical career. The relatively higher mean age of career-changer and career-changer/academic-record-enhancer-program participants suggests that, in contrast to academic-record-enhancer-program participants, participants in career-changer programs were perhaps either employed for wages after college prior to medical-school matriculation or otherwise better-positioned financially, compared with academic-record-enhancer-program participants, to avoid accruing debt due to postbaccalaureate-program participation.

That financial issues may particularly impact academic-record-enhancer-program participants has implications for the design and implementation of postbaccalaureate programs intended to increase the socioeconomic diversity of medical school matriculants. There can be substantial costs involved in academic-record-enhancer postbaccalaureate-program participation for both the student and the institution. The University of California Postbaccalaureate Premedical Programs' year-long academic-enrichment program was administered at a per student cost of \$3500 for the student for tuition and fees and an estimated per student cost of \$14,500 for the institution.¹⁰ Blakely and Broussard noted that high program costs for student participants in their program for educationally disadvantaged students could have the effect of "pricing our target population out of our program."⁷ State governments and the federal government (particularly through the Health Careers Opportunity Program (HCOP)) have been among funding sources for support of some year-long, postbaccalaureate, academic-record-enhancer programs targeting students from educationally or economically disadvantaged backgrounds.^{2, 10} In the economic climate of cutbacks in state funding for educational programs and recent fluctuations in HCOP-funding levels, the challenges of making lengthy academic-record-enhancer programs accessible to students with limited financial means have likely grown. Other approaches to promote successful pursuit of medical careers for some college graduates might include shorter-duration, intensive summer programs prior to medical-school application¹⁷ and comprehensive support programs integrated into the medical-school curriculum.^{18, 19}

We also observed that, among the GQ respondents in our study sample, participation in each type of postbaccalaureate program predicted a greater likelihood of intent at the time of medical-school graduation to practice in an underserved area. This observation extends the finding of a recently published single-institution study, which reported that among its medical graduates, a higher proportion of postbaccalaureate academic-record-enhancer-program participants compared with non-participants were practicing in federally designated underserved areas.²⁰ Our study had several strengths and limitations. Our sample included a national cohort of medical-school matriculants and included both academic-record-enhancer and career-changer-program participants, as well as non-participants. However, as our analysis included only non-degree-granting postbaccalaureate-program participants who matriculated in MD-degree programs at U.S. LCME-accredited medical schools, our results cannot be generalized to enrollees in other degree programs at LCME-accredited medical schools or to postbaccalaureate-program participants who enrolled in other health-professions programs, such as osteopathic medical schools.²¹ Furthermore, we did not have information about the timing of the most recent MCAT scores in relation to

postbaccalaureate-program participation. Students' most recent MCAT scores might reflect performance before, during or after their postbaccalaureate-program participation. Finally, there is substantial variation among the many career-changer and academic-record-enhancer postbaccalaureate programs offered in their selection criteria, design, duration and curricula, which may be individualized to meet specific student needs. Therefore, the characteristics, graduation rates and career intentions at graduation for medical-school matriculants who participated in a specific career-changer or academic-record-enhancer postbaccalaureate-premedical program may differ from our observations for this national sample.

Nonetheless, our results can inform our understanding of the characteristics of postbaccalaureate-program participants, who still comprise substantial numbers of medical-school matriculants. Indeed, 12.7% of 14,152 MSQ respondents in 2009 reported postbaccalaureate-program participation, including 4.5% in academic-record-enhancer programs, 6.7% in career-changer programs, and 1.5% in academic-record-enhancer/career-changer programs (personal communication David Matthew, PhD, Senior Research Analyst, Data Resources and Studies, AAMC, January 26, 2010). For medical schools seeking to implement postbaccalaureate-premedical programs as a means to diversify their applicant pools and enrollees, our results suggest that this objective might best be accomplished by implementing academic-record-enhancer programs, rather than career-changer programs. However, medical-school matriculation of both career-changer-program and academic-record-enhancer-program participants may serve to increase the likelihood that medical graduates will practice in underserved areas, an important and timely consideration in the context of our societal physician-workforce needs.

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Table 1
 Characteristics of Matriculating Student Questionnaire (MSQ) Respondents in the Study Sample, by Participation in Postbaccalaureate Programs

Characteristics	Total No. (%)	Academic- record- enhancer- program participants No. (%)	Career- changer- program participants No. (%)	Academic- record- enhancer/ career-changer- program participants No. (%)	Non- postbaccalaureate- program participants No. (%)
Overall no. (%) of MSQ respondents	57,276 (100)	3,561 (6.2)	3,931 (6.9)	1,354 (2.4)	48,430 (84.6)
Matriculation year					
1996	11,591 (20.2)	679 (19.1)	1,001 (25.5)	185 (13.7)	9,726 (20.1)
1997	11,516 (20.1)	722 (20.3)	859 (21.9)	315 (23.3)	9,620 (19.9)
1998	10,083 (17.6)	635 (17.8)	586 (14.9)	240 (17.7)	8,622 (17.8)
1999	11,895 (20.8)	799 (22.4)	683 (17.4)	375 (27.7)	10,038 (20.7)
2000	12,191 (21.3)	726 (20.4)	802 (20.4)	239 (17.7)	10,424 (21.5)
Gender					
Men	31,636 (55.2)	1,989 (55.9)	1,876 (47.7)	784 (57.9)	26,987 (55.7)
Women	25,640 (44.8)	1,572 (44.1)	2,055 (52.3)	570 (42.1)	21,443 (44.3)
Race/ethnicity					
White	38,455 (67.1)	2,045 (57.4)	3,198 (81.4)	972 (71.8)	32,240 (66.6)
Asian/Pacific Islander	10,972 (19.2)	634 (17.8)	354 (9.0)	179 (13.2)	9,805 (20.2)
URM	7,463 (13.0)	868 (24.4)	347 (8.8)	195 (14.4)	6,053 (12.5)
Other/Unknown	386 (0.7)	14 (0.4)	32 (0.8)	8 (0.6)	332 (0.7)
Research-apprenticeship program for college students					
No	28,403 (49.6)	1,844 (51.8)	3,172 (80.7)	985 (72.7)	22,402 (46.3)
Yes	28,873 (50.4)	1,717 (48.2)	759 (19.3)	369 (27.3)	26,028 (53.7)
Summer academic enrichment program for college students					
No	50,511 (88.2)	2,877 (80.8)	3,751 (95.4)	1,211 (89.4)	42,672 (88.1)
Yes	6,765 (11.8)	684 (19.2)	180 (4.6)	143 (10.6)	5,758 (11.9)
When definitely decided to study medicine					
During college	19,117 (39.5)	1,165 (32.7)	816 (20.8)	309 (22.8)	21,407 (37.4)

Characteristics	Total No. (%)	Academic- record- enhancer- program participants No. (%)	Career- changer- program participants No. (%)	Academic- record- enhancer/ career-changer- program participants No. (%)	Non- postbaccalaureate- program participants No. (%)
Before college	26,226 (54.2)	2034 (57.1)	438 (11.1)	336 (24.8)	29,034 (50.7)
After college	6,835 (11.9)	362 (10.2)	2,677 (68.1)	709 (52.4)	3,087 (6.4)
Any premedical debt					
No	35,423 (61.8)	1,961 (55.1)	2,402 (61.1)	809 (59.7)	30,251 (62.5)
Yes	21,853 (38.2)	1,600 (44.9)	1,529 (38.9)	545 (40.3)	18,179 (37.5)
Parent occupation(s)					
Neither parent a physician or other professional	31,796 (55.5)	2,072 (58.2)	1,958 (49.8)	738 (54.5)	27,028 (55.8)
Other professional	15,550 (27.1)	833 (23.4)	1,168 (29.7)	328 (24.2)	13,221 (27.3)
Physician	9,930 (17.3)	656 (18.4)	805 (20.5)	288 (21.3)	8,181 (16.9)
MCAT scores					
>29	29,661 (51.8)	1,238 (34.8)	2,364 (60.1)	626 (46.2)	25,433 (52.5)
27 – 29	14,804 (25.8)	1,019 (28.6)	938 (23.9)	356 (26.3)	12,491 (25.8)
24 – 26	7,258 (12.7)	649 (18.2)	409 (10.4)	217 (16.0)	5,983 (12.4)
21 – 23	2,698 (4.7)	351 (9.9)	116 (3.0)	89 (6.6)	2,142 (4.4)
18 – 20	1,236 (2.2)	210 (5.9)	41 (1.0)	41 (3.0)	944 (1.9)
< 18	339 (0.6)	75 (2.1)	9 (0.2)	14 (1.0)	241 (0.5)
Not available	1,280 (2.2)	19 (0.5)	54 (1.4)	11 (0.8)	1,196 (2.5)
Undergraduate degree-granting institution Carnegie Classification category					
Research Universities – Very High Research Activity	28,517 (49.8)	1,764 (49.5)	1,969 (50.1)	618 (45.6)	24,166 (49.9)
Other Institutions	1,337 (2.3)	70 (2.0)	84 (2.1)	25 (1.8)	1,158 (2.4)
Baccalaureate Colleges-Arts & Sciences	7,409 (12.9)	472 (13.3)	716 (18.2)	245 (18.1)	5,976 (12.3)
Master's Colleges and Universities	6,582 (11.5)	446 (12.5)	307 (7.8)	144 (10.6)	5,685 (11.7)
Research Universities – High Research Activity and Doctoral/Research Universities	8,722 (15.2)	541 (15.2)	516 (13.1)	204 (15.1)	7,461 (15.4)
Not specified	4,709 (8.2)	268 (7.5)	339 (8.6)	118 (8.7)	3,984 (8.2)

URM, underrepresented minorities (i.e., minorities, including black, Hispanic, and American Indian/Alaska Native, that are underrepresented in medicine relative to their proportions in the general population).

Table 2

Multivariable Logistic Regression Models to Identify Independent Predictors of Each Postbaccalaureate-program-participant Group Compared with Non-participation in Postbaccalaureate Programs*

Variable	Academic-record-enhancer program OR (95% CI)	Career-changer program OR (95% CI)	Both academic-record-enhancer/career-changer program OR (95% CI)
Matriculation year [†]	1.01 (0.99-1.04)	0.95 (0.93 – 0.98) [‡]	1.07 (1.03 – 1.11) [‡]
Gender			
Men (Reference)	1.00	1.00	1.00
Women	0.83 (0.77-0.89) [‡]	1.46 (1.35-1.58) [‡]	0.84 (0.75 – 0.95) [¶]
Race/ethnicity			
White (Reference)	1.00	1.00	1.00
Asian/Pacific Islander	1.07 (0.97-1.18)	0.51 (0.45 – 0.58) [‡]	0.83 (0.70 – 0.98) [§]
URM	1.21 (1.09-1.35) [‡]	1.06 (0.91 – 1.24)	1.02 (0.84 – 1.25)
Other/Unknown	0.75 (0.44-1.29)	1.01 (0.65 – 1.57)	0.83 (0.39 – 1.73)
Laboratory research-apprenticeship during college			
No (Reference)	1.00	1.00	1.00
Yes	0.84 (0.78-0.90) [‡]	0.32 (0.29 – 0.35) [‡]	0.45 (0.40 – 0.51) [‡]
Summer academic enrichment program during college			
No (Reference)	1.00	1.00	1.00
Yes	1.35 (1.22-1.48) [‡]	0.68 (0.57 – 0.81) [‡]	1.13 (0.93 – 1.37)
When decided to study medicine			
During college (Reference)	1.00	1.00	1.00
Before college	1.10 (1.02-1.19) [§]	0.40 (0.35 – 0.45) [‡]	0.72 (0.62 – 0.84) [‡]
After college	2.00 (1.76-2.26) [‡]	15.94 (14.58 – 17.43) [‡]	12.77 (11.08-14.71) [‡]
Any premedical debt			
No (Reference)	1.00	1.00	1.00
Yes	1.25 (1.16-1.35) [‡]	1.08 (1.00 – 1.17)	1.09 (0.97 – 1.23)
Parent occupation			
Neither parent a physician or other professional (Reference)	1.00	1.00	1.00
Other professional	0.89 (0.82 – 0.97) [¶]	1.08 (0.98 – 1.18)	0.89 (0.77 – 1.02)
Physician	1.23 (1.12 – 1.35) [‡]	1.30 (1.17 – 1.45) [‡]	1.31 (1.13-1.53) [‡]
MCAT score categories			
>29 (Reference)	1.00	1.00	1.00
27 – 29	1.76 (1.61-1.92) [‡]	0.95 (0.86 – 1.05)	1.35 (1.17 – 1.55) [‡]
24 – 26	2.30 (2.07-2.56) [‡]	0.97 (0.85 – 1.11)	1.87 (1.57 – 2.23) [‡]

Variable	Academic-record-enhancer program OR (95% CI)	Career-changer program OR (95% CI)	Both academic-record-enhancer/career-changer program OR (95% CI)
21 – 23	3.22 (2.78-3.73) [‡]	0.94 (0.74 – 1.19)	2.60 (1.98 – 3.40) [‡]
18 – 20	4.26 (3.53 – 5.14) [‡]	1.05 (0.71 – 1.55)	3.22 (2.19 – 4.74) [‡]
< 18	6.16 (4.62-8.21) [‡]	0.85 (0.39 – 1.82)	4.76 (2.59 – 8.73) [‡]
Not available	0.34 (0.21-0.54) [‡]	0.82 (0.59 – 1.14)	0.57 (0.31 – 1.06)
Undergraduate degree-granting institution Carnegie Classification category			
Research Universities – Very High Research Activity (Reference)	1.00	1.00	1.00
Other Institutions	0.54 (0.42-0.69) [‡]	0.70 (0.53 – 0.91) [¶]	0.50 (0.33 – 0.76) [‡]
Baccalaureate Colleges – Arts & Sciences	0.96 (0.86-1.06)	1.14 (1.02 – 1.28) [§]	1.28 (1.09 – 1.51) [¶]
Master's Colleges and Universities	0.73 (0.65-0.82) [‡]	0.66 (0.57 – 0.77) [‡]	0.76 (0.62 – 0.93) [¶]
Research Universities – High Research Activity and Doctoral/Research Universities	0.76 (0.68-0.84) [‡]	0.82 (0.73 – 0.93) [‡]	0.87 (0.73 – 1.03)
Not specified	0.92 (0.80-1.05)	0.96 (0.83 – 1.11)	1.08 (0.88 – 1.34)

* OR represents odds ratio; CI, confidence interval; URM, underrepresented minorities (i.e., minorities, including black, Hispanic, and American Indian/Alaska Native, that are underrepresented in medicine relative to their proportions in the general population).

[‡] OR > 1.00 indicates higher likelihood and OR < 1.00 indicates lower likelihood of specialty choice with more recent matriculation year.

[‡] $P \leq .001$.

[¶] $P \leq .01$.

[§] $P \leq .05$.

Table 3

Characteristics of Graduation Questionnaire (GQ) Respondents, by Graduates' Plans to Practice in an Underserved Area

Characteristics	Total No. (%)	No No. (%)	Undecided No. (%)	Yes No. (%)
Overall no. (%) of GQ respondents	46,208 (100)	17,729 (38.4)	18,682 (40.4)	9,797 (21.2)
Gender				
Men (Reference)	25,375 (54.9)	11,247 (63.4)	9,627 (51.5)	4,501 (45.9)
Women	20,833 (45.1)	6,482 (36.6)	9,055 (48.5)	5,296 (54.1)
Race/ethnicity				
White (Reference)	31,591 (68.4)	13,094 (73.9)	12,359 (66.2)	6,138 (62.7)
Asian/Pacific Islander	8,817 (19.1)	3,496 (19.7)	3,997 (21.4)	1,324 (13.5)
URM	5,538 (12.0)	1,040 (5.9)	2,211 (11.8)	2,287 (23.3)
Other/Unknown	259 (0.6)	99 (0.6)	115 (0.6)	48 (0.5)
Postbaccalaureate-program participation				
None (Reference)	39,176 (84.8)	15,325 (86.4)	15,817 (84.7)	8,034 (82.0)
Academic-record-enhancer	2,833 (6.1)	1,011 (5.7)	1,116 (6.0)	706 (7.2)
Career-changer	3,129 (6.8)	1,029 (5.8)	1,317 (7.0)	783 (8.0)
Academic-record-enhancer/career-changer	1,070 (2.3)	364 (2.1)	432 (2.3)	274 (2.8)
Specialty choice				
Other specialties (Reference)	22,446 (48.6)	10,649 (60.1)	8,791 (47.1)	3,006 (30.7)
No specialty chosen	5,009 (10.8)	1,310 (7.4)	2,295 (12.3)	1,404 (14.3)
General internal medicine	2,782 (6.0)	842 (4.7)	1,216 (6.5)	724 (7.4)
Internal medicine subspecialties	4,606 (10.0)	2,110 (11.9)	1,851 (9.9)	645 (6.6)
General pediatrics	3,193 (6.9)	807 (4.6)	1,523 (8.2)	863 (8.8)
Pediatrics subspecialties	1,514 (3.3)	607 (3.4)	641 (3.4)	266 (2.7)
Family medicine	3,997 (8.7)	536 (3.0)	1,218 (6.5)	2,243 (22.9)
Obstetrics and gynecology	2,661 (5.8)	868 (4.9)	1,147 (6.1)	646 (6.6)

URM, underrepresented minorities (i.e., minorities, including black, Hispanic, and American Indian/Alaska Native, that are underrepresented in medicine relative to their proportions in the general population).

Table 4

Multivariable Logistic Regression Models to Identify Independent Predictors of Graduates' Plans to Practice in Underserved Areas, Compared with Not Planning to Practice in Underserved Areas.

	Undecided OR (95% CI)	Yes OR (95% CI)
Graduation year [†]	1.00 (0.98 – 1.01)	1.03 (1.01 – 1.05) [‡]
Gender		
Men (Reference)	1.00	1.00
Women	1.40 (1.34 – 1.46) [‡]	1.49 (1.40 – 1.58) [‡]
Race/ethnicity		
White (Reference)	1.00	1.00
Asian/Pacific Islander	1.24 (1.18 – 1.31) [‡]	0.92 (0.85 – 0.99) [§]
URM	2.28 (2.10 – 2.46) [‡]	5.28 (4.85 – 5.76) [‡]
Other/Unknown	1.31 (1.00 – 1.72)	1.23 (0.85 – 1.79)
Postbaccalaureate-program participation		
None (Reference)	1.00	1.00
Academic-record-enhancer	1.03 (0.94 – 1.13)	1.14 (1.02 – 1.28) [§]
Career-changer	1.27 (1.16 – 1.38) [‡]	1.48 (1.32 – 1.65) [‡]
Academic-record-enhancer/career-changer	1.19 (1.03 – 1.37) [§]	1.47 (1.23 – 1.76) [‡]
Specialty choice		
Other specialties (Reference)	1.00	1.00
No specialty chosen	1.98 (1.84 – 2.13) [‡]	3.68 (3.37 – 4.03) [‡]
General internal medicine	1.67 (1.52 – 1.83) [‡]	2.95 (2.63 – 3.30) [‡]
Internal medicine subspecialties	1.06 (0.98 – 1.13)	1.10 (1.00 – 1.22)
General pediatrics	2.06 (1.88 – 2.26) [‡]	3.37 (3.02 – 3.77) [‡]
Pediatrics subspecialties	1.20 (1.07 – 1.35) [¶]	1.41 (1.21 – 1.65) [‡]
Family medicine	2.66 (2.39 – 2.96) [‡]	15.48 (13.92 – 17.20) [‡]
Obstetrics and gynecology	1.35 (1.22 – 1.48) [‡]	1.91 (1.69 – 2.15) [‡]

* OR represents odds ratio; CI, confidence interval; URM, underrepresented minorities (i.e., minorities, including black, Hispanic, and American Indian/Alaska Native, that are underrepresented in medicine relative to their proportions in the general population).

[†] OR > 1.00 indicates higher likelihood and OR < 1.00 indicates lower likelihood with more recent graduation year.

[‡] $P \leq .001$.

[¶] $P \leq .01$.

[§] $P \leq .05$.