

# Community College Pathways to Medical School and Family Medicine Residency Training

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## ABSTRACT

**PURPOSE** Medical students who attend community college are more likely to express intention to train in family medicine. This study examined whether community college attendance is associated with family medicine residency training in a national sample of US medical school graduates.

**METHODS** We performed a cross-sectional analysis using the Association of American Medical Colleges matriculant files of residency trainees who graduated from medical school between 2010 to 2012. Residency specialty (family medicine vs other) was modeled using logistic regression analysis; the key independent variable was community college attendance, with categories of non-community college (reference); community college while in high school; community college after graduating from high school, then transfer to 4-year university; and community college after graduating from a 4-year university or as a postbaccalaureate. The logistic model adjusted for age, sex, race/ethnicity, years in medical school, parental education (a marker of socioeconomic status), and high school US region.

**RESULTS** Of the 43,382 medical school graduates studied, 25.9% attended community college and 8.7% trained in family medicine. In unadjusted analysis, graduates attending community college while in high school, after graduating from high school with transfer to 4-year university, or after graduating from a 4-year university or as a postbaccalaureate (12.0%, 12.7%, and 10.8%, respectively) were more likely to train in family medicine compared with their peers who did not attend community college (7.7%). Respective adjusted odds ratios were 1.47 (95% CI, 1.33-1.63;  $P < .001$ ), 1.27 (95% CI, 1.06-1.52;  $P = .009$ ), and 1.17 (95% CI, 1.06-2.29;  $P = .002$ ). Among family medicine residents, 32.7% of those who were white, 35.2% of those Asian, 50.8% of those Latino, and 32.7% of those black or African American attended community college.

**CONCLUSIONS** US medical school graduates who attended community college were more likely to train in family medicine, suggesting community college is an important pathway for increasing the primary care workforce.

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## INTRODUCTION

Population growth and health insurance expansion under the Patient Protection and Affordable Care Act demand a vital supply of primary care physicians in the United States.<sup>1-4</sup> Declining medical student interest in primary care<sup>5,6</sup> jeopardizes the sustainability and growth of the primary care workforce. Interest in primary care may begin well before medical school and is influenced by demographic characteristics,<sup>7,8</sup> undergraduate and medical education,<sup>9-13</sup> and residency training.<sup>14</sup> US medical students may begin their undergraduate education at a 4-year university or at a community college with plans to transfer to a 4-year university. According to previous national studies, one-third of medical students attend community college,<sup>15</sup> and such attendance is positively associated with intentions to practice in family medicine.<sup>16</sup> Whether these early career intentions are realized, thus contributing to the family medicine physician workforce, has not been explored.

Premedical community college experiences may influence future specialty interests and choice.<sup>16,17</sup> Community college students may have stronger community ties, and often work part or full time, nurturing a sense of civic duty prevalent in primary care specialties such as family medicine.<sup>17</sup> Many high-achieving, low-income high school students enroll in community colleges with plans to transfer to 4-year universities.<sup>18,19</sup> Community colleges serve a large proportion of Latino, black or African American, and Asian/Pacific Islander students, who are underrepresented in medicine, as well as first-generation college, low-income, and older students.<sup>20,21</sup> Approximately 7.2 million or 40% of all undergraduate college students attend community college. Exploring the characteristics of medical students who attend community college may therefore be of interest to those seeking to increase the primary care workforce.

This study examined the associations of community college attendance with family medicine residency training in a national cohort of US doctor of medicine (MD)-granting medical school graduates (USMGs). We hypothesized the community college pathway would be associated with family medicine residency training given prior research supporting intentions of community college students to pursue this specialty.<sup>16</sup>

## METHODS

### Data Sources

We analyzed deidentified data from the Association of American Medical Colleges (AAMC) matriculant files of 50,791 residency trainees who had graduated from medical school between 2010 and 2012. This data set included variables related to undergraduate and medical education and residency training. After excluding missing data, our final study sample consisted of 43,382 medical school graduates (85.4% of the total); 3,910 (7.7%) were missing residency specialty, 3,232 (6.4%) high school region, and 267 (0.5%) race/ethnicity. This study was reviewed and approved by the University of California, Davis Institutional Review Board.

### College Pathways

Our primary predictor was undergraduate college pathway. Undergraduate college pathways to medical school were determined using the Carnegie Classification of Institutions of Higher Education: (1) attended community college during high school (ie, dual enrollment); (2) attended community college before transferring to a 4-year university; (3) attended community college after graduating from a 4-year university or post-baccalaureate; and (4) never attended community college (non-community college). The rationale for using 3 fundamentally different community college categories

was to account for the heterogeneity in community college attendance and is described in prior studies.<sup>15,16</sup>

### Measures

The primary outcome measure was graduate medical residency training specialty (family medicine vs other). Other residency programs included all other specialty options (eg, pediatrics, internal medicine, psychiatry, neurology, dermatology, radiology, surgery, and others). Internal medicine, pediatrics, and internal medicine–pediatrics were presumed to be categorical programs and thus not considered primary care. Residency selection during postgraduate year 2 was used, so as not to include physicians who switched specialties after their first year of training. Other measures included self-reported sex (female or male), age, race/ethnicity (non-Hispanic white, Asian, black or African American, and Hispanic or Latino), and parental education (less than college or attended college). Time in medical school was calculated as the difference between year of matriculation and year of graduation. Location of each graduate's high school graduation was categorized using US census region—West, Midwest, Northeast, or South—to account for any possible regional variation in community college attendance.

### Analysis

We used Stata version 14.2 (Stata Corp) to conduct analyses. Descriptive statistics included variable frequencies, means, and percentages. Cross-tabulations included unadjusted proportions of students with various characteristics for each outcome. In bivariate analyses, we tested for the statistical significance of unadjusted differences across groups using the  $\chi^2$  test for categorical variables and the ANOVA test for continuous variables.

Logistic regression analysis was performed to explore the associations between each of the 3 community college pathways described above—the key predictor variable—and family medicine residency vs other specialty—the dependent variable. We performed a sensitivity analysis to explore the association between each community college pathway and other potential primary care specialties (internal medicine, pediatrics, and internal medicine–pediatrics vs other specialties). Inclusion of covariates was based on the literature on factors that influence admission to medical school and practice intentions, even if the variables had no statistically significant association in the bivariate analyses.<sup>14-17</sup> In our unadjusted model, the community college pathways were the independent variables, yielding unadjusted odds ratios (ORs). Our adjusted model added student personal characteristics: age, sex, race/ethnicity, years in medical school, parental education (a marker

of socioeconomic status), and high school US region, yielding adjusted odds ratios (AORs). We included adjusted marginal percentages to facilitate interpretation of logistic regression findings. A statistical significance level was set at  $P < .05$  for all analyses.

## RESULTS

Of the 43,382 USMGs from 2010-2012, 25.9% attended community college: 11.2% during high school, 2.9% before transferring to a 4-year university, and 11.9% after graduating from a 4-year university. Table 1 presents their characteristics overall and by college pathway. The majority of medical graduates obtained a medical doctor degree (MD) rather than an MD-dual degree (eg, MD-PhD). A higher proportion of female, black or African American, and Latino medical graduates attended community college. Those attending community college after graduating from a 4-year university were older. On average, graduates attended medical school for 4.25 years, with a stan-

dard deviation of 0.68 years and range of 4 to 9 years. A higher percentage of community college attendees graduated from a high school in the West region compared with the Northeast region.

Table 2 shows characteristics of graduates who trained in family medicine. Of the 43,382 USMGs studied, 3,787 (8.7%) trained in family medicine. Of this group, 1,298 (34.3%) attended community college. In unadjusted analysis, a higher percentage of community college attendees trained in family medicine compared with other residency specialties. Among family medicine residents, 860 of 2,631 (32.7%) of those white, 157 of 446 (35.2%) of those Asian, 136 of 268 (50.8%) of those Latino, 107 of 327 (32.7%) of those black or African American, and 254 of 606 (41.9%) of those who were first-generation college graduates attended community college. Women, whites, blacks or African Americans, Latinos, first-generation college students, and individuals who completed high school in the West region more commonly became family medicine residents as opposed to residents in other specialties.

**Table 1. Characteristics of USMGs 2010-2012 by Undergraduate College Pathway**

Characteristic	Undergraduate College Pathway				P Value <sup>a</sup>	Total
	Non-Community College	High School-Community College	Community College-Transfer	Postbaccalaureate-Community College		
All graduates, No. (%)	32,138 (74.1)	4,846 (11.2)	1,241 (2.9)	5,157 (11.9)	–	43,382 (100)
Program type, No. (%)					<.001	
MD only	29,698 (73.6)	4,535 (11.2)	1,187 (2.9)	4,930 (12.2)		40,350 (100)
MD dual degree	2,440 (80.5)	311 (10.3)	54 (1.8)	227 (7.5)		3,032 (100)
Age, mean (SD), y	23.6 (2.2)	23.5 (2.2)	25.4 (3.4)	24.7 (3.2)	<.001	23.7 (2.4)
Sex, No. (%)					<.001	
Male	16,655 (74.2)	2,413 (10.8)	761 (3.4)	2,605 (11.6)		22,434 (100)
Female	15,483 (73.9)	2,433 (11.6)	480 (2.3)	2,552 (12.2)		20,948 (100)
Race/ethnicity, No. (%)					<.001	
White	21,379 (75.1)	3,043 (10.7)	745 (2.6)	3,318 (11.7)		28,485 (100)
Asian	6,557 (74.1)	1,151 (13.0)	226 (2.6)	916 (10.4)		8,850 (100)
Black or African American	1,879 (72.7)	238 (9.2)	85 (3.3)	383 (14.8)		2,585 (100)
Latino	1,514 (64.6)	282 (12.0)	159 (6.8)	390 (16.6)		2,345 (100)
Multiple	809 (74.4)	132 (11.8)	26 (2.3)	150 (13.4)		1,117 (100)
Time in medical school, mean (SD), y	4.25 (0.70)	4.25 (0.68)	4.27 (0.69)	4.21 (0.59)	<.001	4.25 (0.68)
First-generation college student, No. (%)	2,893 (62.8)	714 (15.5)	294 (6.4)	706 (15.3)	<.001	4,607 (100)
High school US region, No. (%)					<.001	
West	5,174 (57.9)	1,924 (21.6)	479 (5.4)	1,351 (15.1)		8,928 (100)
Midwest	8,273 (75.0)	1,060 (9.6)	267 (2.4)	1,426 (12.9)		11,026 (100)
Northeast	8,255 (88.4)	319 (3.4)	98 (1.1)	671 (7.2)		9,343 (100)
South	10,436 (74.1)	1,543 (11.0)	397 (2.8)	1,709 (12.1)		14,085 (100)

USMG = US doctor of medicine (MD)-granting medical school graduate.

Notes: Non-community college: medical graduates who never attended a community college; high school-community college: medical graduates who attended a community college while in high school and before graduating from high school; community college-transfer: medical graduates who attended a community college after graduating from high school and before transferring to a 4-year university; postbaccalaureate-community college: medical graduates who attended a community college after graduating from a 4-year university.

<sup>a</sup>ANOVA test for continuous variables and  $\chi^2$  test of differences for proportions when both variables were categorical.

**Table 2. Comparison of USMGs 2010-2012 Who Trained in Family Medicine Residency vs Other Residency Specialties**

Characteristic	Family Medicine (n = 3,787)	Other Residency Specialties <sup>a</sup> (n = 39,595)	P Value <sup>b</sup>
College pathway, No. (%)			<.001
Non-community college	2,489 (7.7)	29,649 (92.3)	
High school-community college	580 (12.0)	4,266 (88.0)	
Community college-transfer	157 (12.7)	1,084 (87.4)	
Postbaccalaureate-community college	562 (10.9)	4,596 (89.1)	
Program type, No. (%)			<.001
MD only	3,551 (8.8)	36,799 (91.2)	
MD dual degree	236 (7.8)	2,796 (92.2)	
Age, mean (SD), y	23.7 (2.4)	24.4 (2.9)	<.001
Female, No. (%)	2,245 (59.3)	18,703 (47.2)	<.001
Race/ethnicity, No. (%)			<.001
White	2,631 (9.2)	25,854 (90.8)	
Asian	446 (5.0)	8,404 (95.0)	
Black or African American	327 (12.6)	2,258 (87.4)	
Latino	268 (11.4)	2,077 (88.6)	
Multiple	115 (10.3)	1,002 (89.7)	
Time in medical school, mean (SD), y	4.31 (0.65)	4.24 (0.69)	<.001
First-generation college student, No. (%)	606 (13.2)	4,001 (86.8)	<.001
High school US region, No. (%)			<.001
West	928 (10.4)	8,000 (89.6)	
Midwest	1,128 (10.2)	9,898 (89.8)	
Northeast	548 (5.9)	8,795 (94.1)	
South	1,183 (8.4)	12,902 (91.6)	

USMG = US doctor of medicine (MD)-granting medical school graduate.

Notes: Non-community college: medical graduates who never attended a community college; high school-community college: medical graduates who attended a community college while in high school and before graduating from high school; community college-transfer: medical graduates who attended a community college after graduating from high school and before transferring to a 4-year university; postbaccalaureate-community college: medical graduates who attended a community college after graduating from a 4-year university.

<sup>a</sup>Pediatrics, internal medicine, neurology, dermatology, radiology, surgery, and other specialties.

<sup>b</sup>ANOVA test for continuous variables and  $\chi^2$  tests of differences for proportions when both variables were categorical.

Table 3 shows the results of the logistic regression analyses. In the adjusted model, medical graduates who attended community college were more likely to train in family medicine compared with those who did not attend community college, a pattern seen across the 3 pathways: attended community college during high school (AOR = 1.47; 95% CI, 1.33-1.63;  $P < .001$ ), attended community college before transferring to a 4-year university (AOR = 1.27; 95% CI, 1.06-1.52;  $P = .009$ ), and attended community college after graduating from 4-year university or postbaccalaureate (AOR = 1.17; 95% CI, 1.06-2.29;  $P = .002$ ). The area under the receiver operating characteristic curve was 0.65. Supplemental Table 1 (available at <http://www.annfammed.org/content/16/4/302/suppl/DC1/>) shows the complete logistic regression analysis, including AORs for all covariates.

Sensitivity analysis revealed that community college attendance was not significantly associated with

pursuing an internal medicine, pediatrics, or internal medicine-pediatrics residency.

## DISCUSSION

To our knowledge, this is the first study to examine the association between undergraduate college pathways and family medicine residency training. After adjusting for confounders, USMGs who attended community college were more likely to train in family medicine when compared with those who never attended community college. Notably, 33% of whites, 35% of Asians, 32% of blacks or African Americans, 51% of Latinos, and 42% of first-generation college students within the family medicine residency workforce attended community college. Our findings are also consistent with prior research demonstrating an association between attending community college and interest in family medicine as a specialty.<sup>16</sup> Furthermore, this study adds to the body of literature on factors associated with family medicine residency.<sup>5,7,22</sup> Nurturing early interest in family medicine during high school and community college may be a strategy to increase the supply and diversity of the

primary care physician workforce in the United States. A greater number of mentoring programs such as the California Future Faces of Family Medicine may help by facilitating collaborations between family medicine physician associations, local family medicine residency programs, medical schools, community colleges, universities, and high schools.<sup>23</sup>

Attending community college before graduating from high school, also referred to as community college dual enrollment, has become much more common in the United States over the past 2 decades.<sup>19</sup> Two-thirds of community college dual enrollment students are from low- or middle-income families.<sup>19</sup> Future studies should further explore the mechanism by which community college attendance may influence family medicine residency selection. Students attending community college may face additional socioeconomic disadvantages or participate in unique programs that

**Table 3. Odds of Training in Family Medicine Residency Among USMGs 2010-2012 by Undergraduate College Pathway**

College Pathway	Odds Ratio (95% CI)	P Value <sup>a</sup>	Marginal % (95% CI)
Unadjusted analysis			
Non-community college	Reference	–	7.7 (7.5-8.0)
High school–community college	1.62 (1.47-1.78)	<.001	12.0 (11.1-12.9)
Community college–transfer	1.72 (1.45-2.05)	<.001	12.7 (10.8-14.5)
Postbaccalaureate–community college	1.45 (1.32-1.60)	<.001	10.9 (10.0-11.7)
Adjusted analysis <sup>b</sup>			
Non-community college	Reference	–	8.1 (7.8-8.4)
High school–community college	1.47 (1.33-1.63)	<.001	11.4 (10.5-12.3)
Community college–transfer	1.27 (1.06-1.52)	.009	10.1 (8.5-11.6)
Postbaccalaureate–community college	1.17 (1.06-1.29)	.002	9.3 (8.6-10.1)

USMG = US doctor of medicine (MD)-granting medical school graduate.

Notes: Non-community college: medical graduates who never attended a community college; high school–community college: medical graduates who attended a community college while in high school and before graduating from high school; community college–transfer: medical graduates who attended a community college after graduating from high school and before transferring to a 4-year university; postbaccalaureate–community college: medical graduates who attended a community college after graduating from a 4-year university.

<sup>a</sup>Wald test.

<sup>b</sup>Adjusted for age, sex, race/ethnicity, years in medical school, parental education, high school US region.

shape their career interests. They may be supported by primary care–focused enrichment programs associated with the Health Resources and Services Administration's Area Health Education Centers (AHECs).<sup>24</sup> AHEC partnerships between high schools and family medicine residency programs may partly explain our findings, highlighting the need for continued investments in premedical enrichment programs that include community colleges.

Our study's findings are consistent with national data demonstrating that only 9.6% of all USMGs train in family medicine.<sup>4</sup> Over the past decade, USMGs have constituted just 46% of residents in accredited family medicine residency training programs.<sup>4</sup> At the same time, the ratio of primary care physicians to the US population continues to decline,<sup>25,26</sup> and the increasing number of physician assistants and nurse practitioners remains insufficient to meet primary care workforce needs.<sup>27</sup> Our study's findings highlight the need to reassess the importance of community college attendance in the medical school admissions processes as a potential means to ameliorate the primary care shortage.

This study was a retrospective cross-sectional analysis and was limited by the lack of data on some individual-level factors (eg, debt, class ranking, honors, and other academic accolades) that may be influential in residency selection. Demographic variables were self-reported, and residency-level data were limited to postgraduate years 1 and 2. The AAMC matriculant data file did not include osteopathic or non-American

Medical College Application medical student data. There may be some residents who do not complete training or decide to switch after the second postgraduate year. It is unclear whether the findings apply to other primary care specialties such as pediatrics or internal medicine because the data did not distinguish between primary care and categorical (non–primary care) specialty residency programs. According to the American College of Physicians, internal medicine residency graduates represent 20% to 25% of those entering the primary care workforce; a similar pattern has been reported in pediatric residencies.<sup>28</sup> It is therefore unlikely that these non–family medicine primary care specialties would substantially affect the findings on the importance of the community college pathway.

In conclusion, attending community college provides a viable pathway for students to pursue a career in medicine and ultimately become primary care physicians. Further strengthening the community college pathway may increase the diversity and supply of the US primary care physician workforce. More research is needed to longitudinally follow high school, community college, and 4-year university students to better understand how various experiences or programs influence their career decisions.

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**Key words:** community college; education, premedical; education, medical; minority groups; family medicine; primary care; health workforce

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