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DOI: 10.1377/hlthaff.2019.00924
HEALTH AFFAIRS 38,
NO. 12 (2019): 2011–2018

The Decline In Rural Medical Students: A Growing Gap In Geographic Diversity Threatens The Rural Physician Workforce

ABSTRACT Growing up in a rural setting is a strong predictor of future rural practice for physicians. This study reports on the fifteen-year decline in the number of rural medical students, culminating in rural students' representing less than 5 percent of all incoming medical students in 2017. Furthermore, students from underrepresented racial/ethnic minority groups in medicine (URM) with rural backgrounds made up less than 0.5 percent of new medical students in 2017. Both URM and non-URM students with rural backgrounds are substantially and increasingly underrepresented in medical school. If the number of rural students entering medical school were to become proportional to the share of rural residents in the US population, the number would have to quadruple. To date, medical schools' efforts to recognize and value a rural background have been insufficient to stem the decline in the number of rural medical students. Policy makers and other stakeholders should recognize the exacerbated risk to rural access created by this trend. Efforts to reinforce the rural pipeline into medicine warrant further investment and ongoing evaluation.

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As of the 2010 census nearly sixty million people lived in rural communities in the US, and almost one in five people in the US were rural residents.[1] Although popular media often highlight compelling narratives of a specific region or rural community in decline and seek to make broad generalizations about rural depopulation, the overall size of the US rural population has been stable for several decades.

Rural populations have higher rates of many chronic illnesses and have not enjoyed the same gains in life expectancy that urban populations have in recent decades.[2,3] People living in rural communities are less likely to receive recommended preventive services than their urban counterparts are.[4] Compared to urban hospitals, rural hospitals have higher rates of maternal morbidity[5] and infant mortality.[6] Recent losses of obstetric services have also disproportionately affected rural counties that have high percentages of minority women of reproductive age.[7]

More than 15 percent of rural residents are members of racial/ethnic minority groups, and this percentage is increasing.[8,9] Research has demonstrated that members of rural minority groups—particularly black, Hispanic, and American Indian/Alaska Native populations—face higher chronic disease burdens and worse access to care than non-Hispanic white rural residents.[10]

Physician shortages in rural settings, which are magnified by the disproportionate health care needs of rural communities, have been a widespread and perennial challenge. Only 11 percent of the physician workforce practices in rural communities,[11] and as of 2019 over 62 percent of all federally designated primary care Health Pro-

fessional Shortage Areas were in rural areas.[12] This gap in access to physician care is likely to be an important contributor to increased rural morbidity and mortality.

The recent significant growth in the number of new US medical schools and the increase in size of existing ones presents an opportunity to train a workforce better suited to meeting the needs of rural communities. Unfortunately, that growth has been accompanied by a decrease in the percentage of students who report an interest in practicing in small towns and rural communities.[13] This decline in interest in rural practice may be because medical education, most of which is based in metropolitan areas, disproportionately exposes future physicians to medical practice in urban and suburban settings. It may also be driven by a paucity of incoming students who have experienced a rural lifestyle, including being familiar with the distinct cultural aspects of small-town life. This is important because multiple studies have demonstrated that students from rural backgrounds are much more likely to decide to practice in rural settings.[14–20]

Research has similarly shown that physicians from racial/ethnic minority groups that are traditionally underrepresented in medicine (URM) are more likely to practice in underserved communities and provide care to minority populations.[21,22] Important research and coordinated efforts have focused attention on strengthening the pipeline of URM students and on the importance of racial/ethnic diversity in medical school and the physician workforce.[23–25]

Despite widespread recognition of the need for more rural physicians, we are aware of no longitudinal national studies that have examined the proportion of rural students who apply, are admitted, and matriculate to medical school. Given the importance of ensuring equitable access to care for rural populations, we sought to better understand these trends over time for MD-granting schools in the US.

Study Data And Methods

DATA SOURCES AND ANALYTIC APPROACH We obtained data on applicants and matriculants from the American Medical College Application Service for the period 2002–03 through 2017–18 (hereafter, academic years are referenced by the first year, so the two year ranges above are presented as 2002 and 2017). Only people who were born in the US or were permanent residents who graduated from high school in the US were included in our sample. Because of data limitations, people from any of the US territories could not have a rural status assigned to them, except those who were born or graduated from high school in a county in one of the fifty states or in the District of Columbia.

This study was approved by the American Institute of Research Institutional Review Board.

We used the 2013 Rural-Urban Continuum Codes[26] of each applicant's birth and high school graduation counties to identify rural background. Applicants were considered to be from a rural background if either their birth or high school graduation county had a code of 6 (meaning that the county had an urban population of 2,500–19,999 and was adjacent to a metropolitan area) through 9 (meaning that the county was completely rural or had an urban population of fewer than 2,500 people and was not adjacent to a metropolitan area). All others were considered to be from an urban background. Applicants who applied in multiple years were counted in each year, and the data include the outcome for each year (accepted or not accepted)—with the exception that only one accepted record was included for those who deferred admission.

We examined the trend in numbers of applicants and matriculants from rural and urban backgrounds and compared rural and urban counterparts on key demographic and academic factors, including age, sex, URM status, Medical College Admission Test (MCAT) score quintile, grade point average (GPA), and highest parental education.

We used the MCAT score quintile rather than the actual score because of changes in MCAT scoring over the study period. The Association of American Medical Colleges administers the MCAT. The version used from 1991 to January 2015 (MCAT91) was revised, and a new version was implemented after January 2015 (MCAT15). These versions are scored differently and on different scales. Thus, for all applicants who took the MCAT91, we calculated score quintiles and assigned them to a quintile group, and we applied the same method to assign applicants who took the MCAT15 to a quintile group. This approach allowed us to combine data from individuals throughout the study period. For each person in a given year, we assigned a quintile based on the most recent MCAT score.

We then used a logistic regression model to examine the likelihood of acceptance to any medical school for rural and urban applicants, controlling for age, sex, MCAT quintile, GPA, URM status, highest parental education, and application year (additional information on the details of the regression model is available from the authors on request). For applicants who were accepted, we also employed a logistic regression model to evaluate the likelihood of matriculating for rural and urban students, controlling for the same demographic and academic characteris-

tics. Poisson regression was used to obtain the relative risk estimates for each of these models.

LIMITATIONS The study had important limitations that should be acknowledged. First, rural identity and experience can be assessed in a variety of ways and are unlikely to be fully captured by the traditional measures used in medical school applications and in this study.[27] A more in-depth, qualitative assessment of rural background might have yielded different results, but using such an assessment would be impractical in a longitudinal national study such as this one. We anticipate that the trends identified in this study would be likely to be correlated over time with other measures of rural background.

Second, we were unable to consider in our regression analyses all applicant characteristics that might have influenced acceptance to medical school.

Third, the study focused on students at MD-granting medical schools who had rural backgrounds, using metrics consistent with those available to medical school admission committees. Doctor of osteopathy students, students at international medical schools, and nonphysician clinicians were beyond the scope of this analysis, though each of these groups contributes meaningfully to the rural workforce. Like MD-granting schools, osteopathic medical schools and training programs for physician assistants and nurse practitioners have grown dramatically in number as well as in aggregate size of graduating classes. Future research should explore the degree to which the trends reported here are generalizable across these different clinician groups.

Study Results

There were 618,856 applicant records and 281,845 matriculants who satisfied our inclusion criteria. Compared to urban applicants, rural applicants were more likely to be men and were slightly older (exhibit 1). While rural appli-

EXHIBIT 1

Applicants and matriculants to US MD-granting medical schools for academic years beginning 2002–17, by rural or urban background

	Applicants				Matriculants			
	Rural		Urban		Rural		Urban	
	No.	%	No.	%	No.	%	No.	%
Sex								
Female	16,786	46.0	273,190	48.0	7,229	44.9	125,262	48.3
Male	19,679	54.0	295,397	52.0	8,877	55.1	134,003	51.7
Underrepresented in medicine[a]								
Yes	3,866	10.7	91,751	16.6	1,433	9.0	38,185	15.1
No	32,303	89.3	462,447	83.4	14,556	91.0	215,406	84.9
MCAT score (quintile)								
1 (lowest)	10,501	29.1	119,479	21.3	1,307	8.3	12,481	4.9
2	8,287	23.0	102,369	18.3	3,269	20.7	30,612	12.1
3	8,429	23.4	134,361	24.0	4,808	30.4	65,790	26.0
4	5,496	15.2	113,841	20.3	3,806	24.0	73,613	29.1
5 (highest)	3,380	9.4	90,117	16.1	2,641	16.7	70,335	27.8
Grade point average								
Median or below	16,489	45.3	291,681	51.4	4,290	26.7	84,182	32.5
Above median	19,902	54.7	275,747	48.6	11,799	73.3	174,745	67.5
Highest parental education								
Less than bachelor's degree	9,307	26.4	102,174	18.6	3,503	22.3	35,588	14.1
Bachelor's degree	9,869	28.0	134,529	24.4	4,404	28.1	56,158	22.2
More than bachelor's degree but less than doctorate	8,376	23.8	146,783	26.7	4,011	25.6	70,607	27.9
Doctorate or higher	7,642	21.7	167,298	30.4	3,757	24.0	90,403	35.8
Mean age, years (SD)	24.8 (3.8)	—[b]	24.4 (3.3)	—[b]	24.2 (3.0)	—[b]	23.9 (2.7)	—[b]

SOURCE Authors' analysis of data from the American Medical College Application Service for 2002–03 through 2017–18. **NOTES** To identify rural background consistently, the sample was limited to people born in or permanent residents of the US who graduated from high school in the US. Applicants who applied in multiple years were counted in each year, and the data include the outcome for each year (accepted or not accepted)—with the exception that only one accepted record was included for people who deferred admission. Total counts may vary across some variables because of occasional missing data within student applications. MCAT is Medical College Admission Test. SD is standard deviation. [a]Black, Hispanic, American Indian/Alaska Native, or Pacific Islander. [b]Not applicable.

cants had higher GPAs, their MCAT scores were lower than those of their urban peers, and, on average, they came from households with lower parental educational attainment, as measured by postsecondary and professional degrees. There was no noticeable change in the relative performance of rural and nonrural applicants on the MCAT or in terms of cumulative GPA over time (data available from the authors). Only 10.7 percent of rural applicants were from groups considered to be underrepresented in medicine.

The number of applicants from a rural background declined 18 percent during the study period, from 2,479 in 2002 to 2,032 in 2017 (exhibit 2). During this same period the number of urban applicants increased by 59 percent, from 27,023 to 42,894.

The number of matriculants from a rural background also declined during this period, from 1,186 in 2002 to 852 in 2017 (exhibit 3)—a decrease of 28 percent. Concurrently, the number of urban matriculants increased by 35 percent, from 13,871 to 18,745. Students from rural backgrounds made up only 4.3 percent of the total incoming medical student body in both 2016 and 2017—a smaller share than that in any previous years in the study period.

Among urban matriculants, both non-URM and URM groups increased in number over the study period, by 3,008 students, to 14,756 (a 25 percent increase), and by 1,541 students, to 3,436 (an 81 percent increase), respectively.

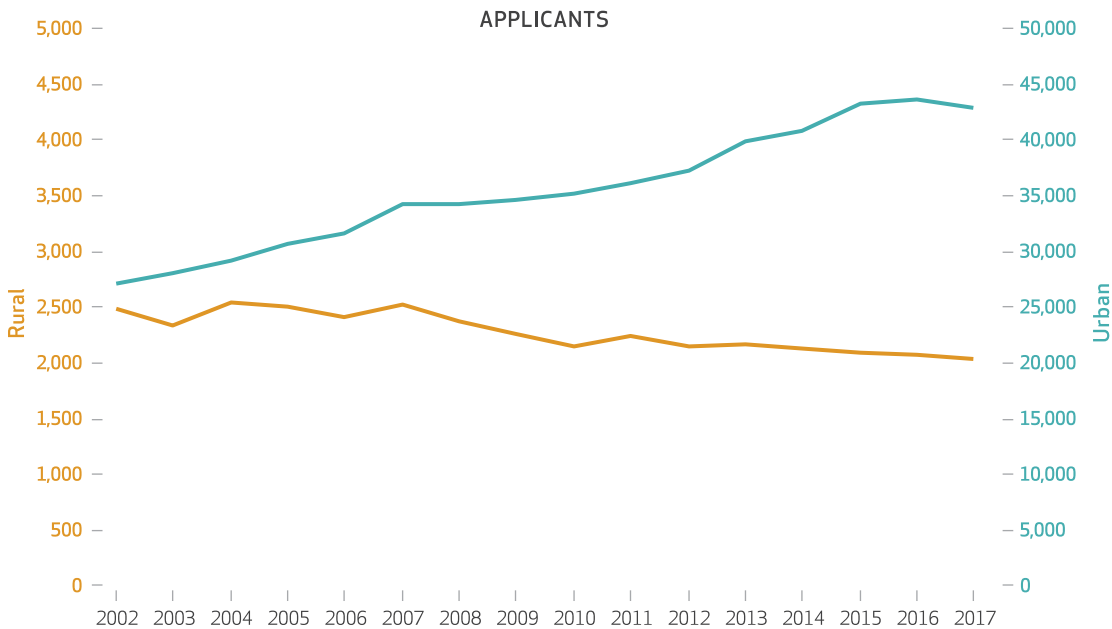
In contrast, there was a decline among rural non-URM matriculants, from 1,090 in 2002 to 748 in 2017 (a 31 percent decrease). In the same period, rural URM matriculants experienced limited growth overall (an 11.5 percent increase), though only 97 students in this category entered medical school in 2017. In that academic year 1 in 8 incoming rural students was from a URM group. Rural URM students accounted for just 1 in 200 incoming medical students overall.

Regression analyses examined the likelihood of acceptance for rural URM, rural non-URM, and urban URM students, compared to urban non-URM applicants (the most prevalent group). Results showed that rural URM, urban URM, and rural non-URM applicants had an increased likelihood of acceptance to medical school: 79 percent, 70 percent, and 13 percent higher, respectively (exhibit 4).

We used the same covariates in a regression model to estimate the likelihood of matriculation for rural accepted applicants, compared to their urban counterparts. Given the very high probability of matriculating for any admitted student (over 98 percent), there was no difference between rural and urban applicants in terms of the probability of matriculation once they were accepted.

EXHIBIT 2

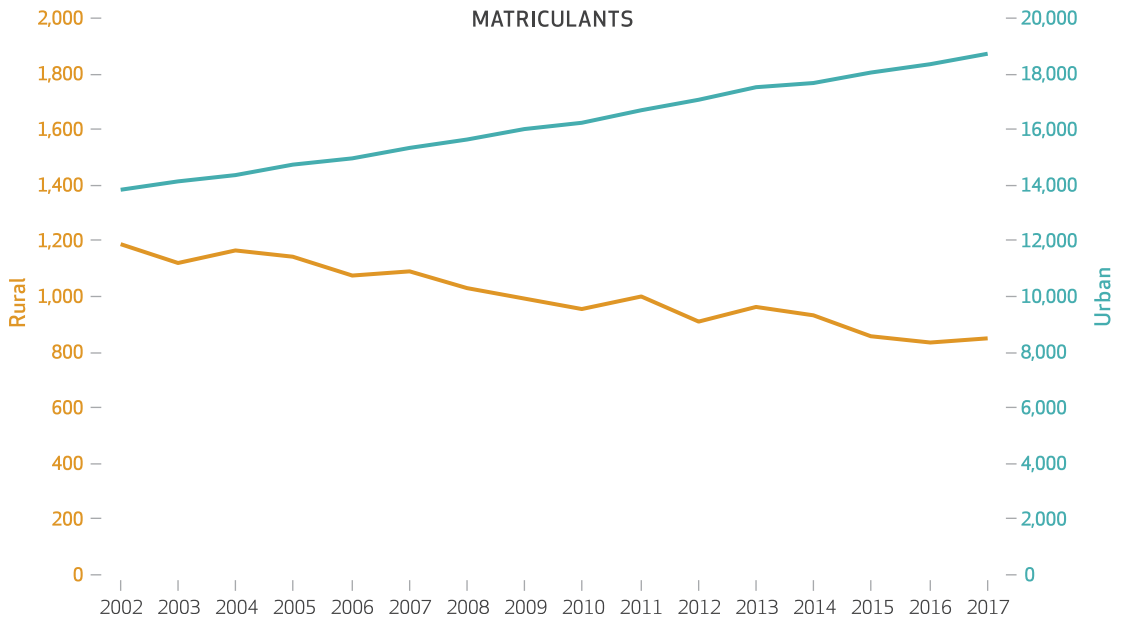
Applicants to medical school for academic years beginning 2002–17, by rural or urban background



SOURCE Authors' analysis of data from the American Medical College Application Service, for 2002–03 through 2017–18. **NOTE** Rural or urban background could not be ascertained for 2.2 percent of the applicants included in the study.

EXHIBIT 3

Matriculants to medical school for academic years beginning 2002–17, by rural or urban background



SOURCE Authors' analysis of data from the American Medical College Application Service for 2002–03 through 2017–18. **NOTE** Rural or urban background could not be ascertained for 2.2 percent of the matriculants included in the study.

Discussion

Physician workforce shortages in rural and remote areas of the US are persistent and growing. The shortage of rural physicians contributes to rural-urban health disparities, including a widening disparity in life expectancy.[2,3] To date, health care workforce policy solutions have been inadequate to meet the challenge. Given that a

EXHIBIT 4

Likelihood ratios for acceptance to medical school for academic years beginning 2002–17, by selected variables

Variable	Likelihood ratio	95% CI
Sex (ref: male)		
Female	1.17	(1.17, 1.18)
MCAT score (ref: quintile 1 [lowest])		
Quintile 2	2.98	(2.93, 3.03)
Quintile 3	4.85	(4.78, 4.93)
Quintile 4	6.33	(6.23, 6.43)
Quintile 5 (highest)	7.32	(7.20, 7.44)
Grade point average (GPA) (ref: median or below)		
Above median	1.69	(1.68, 1.70)
Urban/rural and URM/non-URM (ref: urban non-URM)		
Rural non-URM	1.13	(1.11, 1.14)
Rural URM	1.79	(1.72, 1.86)
Urban URM	1.70	(1.69, 1.72)
Highest parental education (ref: less than bachelor's degree)		
Bachelor's degree	0.97	(0.96, 0.98)
More than bachelor's degree but less than doctorate	1.02	(1.01, 1.02)
Doctorate or higher	1.07	(1.06, 1.08)

SOURCE Authors' analysis of data from the American Medical College Application Service for 2002–03 through 2017–18. **NOTES** The exhibit shows the risk ratios and associated confidence intervals obtained from a Poisson regression with a robust error variance estimate ($N = 563{,}871$). Analyses controlled for age, sex, Medical College Admission Test (MCAT) score, GPA, parental education, and application year. CI is confidence interval. URM is underrepresented racial/ethnic minority group in medicine.

rural background is a strong predictor of practicing in a rural community, policies and programs that support the rural pipeline into medicine may warrant prioritization. Understanding recent trends in rural student application, admission, and matriculation is an important precursor to considering policies and later evaluating them to determine which are the most effective.

The declining pool of rural applicants suggests that more needs to be done to help rural children and young adults identify a pathway to becoming a physician. Support for premedical pipeline programs for people from rural backgrounds may help bridge gaps in achievement and readiness for medical school, helping rural students overcome educational disparities that prevent them from seeking careers in medicine.[28] For example, pipeline programs can make high school students aware of medical career opportunities and help them prepare college applications. At the college level, these programs can offer MCAT preparation courses, medical school application assistance, financial aid education, and opportunities to shadow physicians.[29–32] As a group, rural students' parents have lower levels of educational attainment, and they may be less likely to have the means to independently provide these opportunities and resources to their children.[33]

In many states Area Health Education Centers have been an important source of programming for the health care pipeline. However, the centers receive highly variable support at the state level, and federal funding is continually in jeopardy. Providing secure and robust funding for the centers—along with requirements for evidence-based programming that both meaningfully exposes rural youth to relatable mentors and provides longitudinal support to promote confidence and competitiveness for the pursuit of a career in medicine—could be an effective way to build on existing infrastructure. Research would be needed to ensure that these funds led to desired outcomes.

This study suggests that on the whole, medical schools' admission processes recognize and value applicant diversity, including rural background and underrepresented racial/ethnic groups. Transparency about recent trends may aid medical schools' future efforts. Over a period in which there has been incremental progress in representation of URM students in medical school (although significant additional progress is needed), there has been a 28 percent decrease in the number of matriculants from rural backgrounds. This decline has occurred even in the context of substantial medical school expansion. Many new medical schools appear to focus on traditionally underrepresented students, including traditional URM groups and those from households with lower socioeconomic status.[13] Having new and established schools consider rural background as an important component of a diverse student body and tracking the schools' effectiveness in increasing diversity in this area could have a significant impact on the dearth of rural students, thereby supporting the future adequacy of the rural workforce.[34]

While overall gains have been made in terms of minority students entering medicine, they have largely excluded rural minorities.

The fact that the matriculant pool has dropped more extensively than the applicant pool over time suggests that there is a growing mismatch between the qualifications of rural applicants and medical schools' admissions priorities. The somewhat higher likelihood that non-URM applicants with rural backgrounds will be accepted, compared to their urban peers—after other factors that are independently influential in gaining admission are controlled for—is not enough to offset this discrepancy. There has not been a noticeable change in rural applicants' qualifications, compared to those of urban applicants: Rural applicants perform less well on the MCAT, although their GPAs are higher (data available from the authors). However, a number of other factors that influence admission decisions were not included in our analyses. For instance, studies have shown that rural applicants tend to perform worse than urban applicants on multiple mini-interviews.[35] Other experiential factors valued by medical schools, such as research experience, may also be less prevalent among rural applicants. These factors require further study and potential interventions to ensure that rural applicants are competitive. Also valuable would be more widespread adoption of holistic admissions practices that value a broad set of life and leadership experiences among applicants when assembling a student body that reflects a diverse set of skills and backgrounds.[36,37]

Describing the composition of rural communities using national aggregate data masks significant heterogeneity in the racial/ethnic makeup across different rural regions of the country. This study highlighted the deeper disparities that exist at the intersection of rural and underrepresented racial/ethnic groups in medicine. In particular, while overall gains have been made in terms of minority students entering medicine, those gains have largely excluded rural minorities.

Efforts to increase the number of medical students from rural backgrounds can be augmented by additional efforts during training. For instance, rural medical school programs that are housed in rural communities have demonstrated success in attracting rural applicants and graduating students who eventually practice in rural communities.[20] These models allow students to learn in rural health care systems, helping students build skills necessary for rural practice. By placing medical school campuses in rural communities, these institutions also provide academic role models in medicine to high school and college students in these communities.

Creating rural campuses in proximity to high-need rural populations is limited by cost and complexity. Exposure to rural life and rural practice can occur more readily, if not as comprehensively, through clinical rotations in rural settings, especially longitudinal integrated clerkships.[38,39] Offering rural training experiences and other opportunities to interact with rural physicians should be a priority for medical schools that care about the problem of insufficient rural capacity in their region or across the nation.

Conclusion

From a workforce pipeline perspective, this study has made it clear that students from a rural background are an increasingly underrepresented group in medical school. Four times the number of rural medical students would be required for these students to be proportional to rural representation in the overall US population. Given that trends over time have been in the opposite direction, we believe that efforts to enhance the rural pipeline warrant consideration.

Policy makers and other stakeholders should recognize the growing risk created by the decline in medical students with rural backgrounds, particularly in the absence of robust options to enhance the rural workforce. Rural background is strongly associated with service to rural and underserved populations, as well as entry into primary care.[19,20] These represent two of the most persistent areas of unmet health care workforce needs in the United States. Thus, rural background should be included in any consideration of adequate medical student diversity, along with a recognition that both URM and non-URM rural students are increasingly underrepresented relative to the nation's population. While solutions will require sustained, multifaceted efforts, increased awareness and ongoing measurement of this disparity are crucial first steps. ■

NOTES

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