

INCREASING THE MEDICAL SCHOOL APPLICANT POOL: A KEY TO TRAINING MORE RURAL PHYSICIANS

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Context: Workforce studies show shortages of physicians in many areas of the United States. These shortages are especially severe in states such as Kentucky with many rural counties and are predicted to worsen in the future unless there are changes throughout our educational system to build aspirations and prepare students for medical school education. **Purpose:** To examine rural-urban differences and community characteristics of applicants and matriculants to Kentucky's two allopathic medical schools and influences on the educational aspirations of young students who wish to become physicians. **Methods:** The number of Kentucky applicants and matriculants to allopathic medical schools was obtained from the Association of American Medical College's data warehouse for the period from 2002-2006. A continuous, multidimensional measure was used to classify counties by degree of rurality. Socio-demographic variables were selected for the counties of residence for applicants and matriculants. Model variables were tested in a least squares multiple regression model for their ability to explain patterns among Kentucky's 120 counties in the number of both resident applicants and matriculants to medical school. Data from a survey of middle school participants in summer health camps were analyzed to help identify important influences on young students aspiring to a career as a health professional, especially becoming a physician, and how these might be supported to increase the supply of rural medical school applicants. **Findings:** The low number of rural applicants to medical school was highly correlated with the relative rurality of their county of residence, a low physician-to-population ratio and a low number of total primary care physicians. The percentage of

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county residents having a bachelor's degree level of education or higher had a positive impact on the application rate. Respondents became interested in health careers at age 15 or younger, and parents and grandparents, teachers, and close associates stimulated their aspirations, with teachers being the most influential. **Conclusions:** Prospective students respond to their perception of need for physicians. Rural students are influenced by those who are more highly educated. To overcome the shortage of physicians in rural communities efforts must be made to increase the aspirations for medical education of prospective students from rural counties.

INTRODUCTION

The effects of the physician workforce shortage are being felt across the nation, especially in rural areas. Whereas 20% of the nation's population lives in rural counties, only 11% of the nation's physicians practice in rural communities.¹ Kentucky, for example, is facing a greater deficit in rural physicians than the nation as a whole. Kentucky ranks 32nd nationally in physician-to-population ratio, with only 213.5 doctors per 100,000 residents. In 2007, the Kentucky Institute of Medicine (KIOM) found that 43% of Kentucky residents lived in rural counties, but only 23% of allopathic physicians practice in rural areas of the state.² If current

workforce shortage trends continue (eg, aging population, more chronic diseases, early physician retirement), the demand for more physicians will be much greater than at the present time.

In order for Kentucky and the nation to ameliorate the current and predicted physician deficits, they must act upon recommendations to increase access to health care. Chief among these recommendations is the need to increase the number of students attending medical school. The Council on Graduate Medical Education has predicted a national shortage of 85,000 physicians by 2020,³ and the KIOM predicts a shortage of 2,765 physicians to meet Kentucky's demand by 2020. To help prevent this predicted shortage of physicians, the Association of American Medical Colleges has recommended that existing medical schools increase their enrollment by 30%.⁴ The KIOM Comprehensive Statewide Physician Workforce Study² recommends increasing the number of medical school students as a crucial component of any strategy for increasing the physician supply and diversifying the workforce.

In addition to efforts to increase total enrollment, medical schools should commit to increasing the enrollment of students from rural counties. If this is to occur, the number of applicants to medical schools from rural areas must also increase correspondingly. The number of medical school applicants applying from rural and medically underserved areas is small compared to the need for physicians in those areas. The purpose of this study is to determine the causes of low applicant pools from rural areas and to make recommendations for increasing the rural applicant pool from underserved counties. Applicant-matriculant data from Kentucky's two allopathic medical schools are used to examine our research questions and to explicate trends in applications to medical school by residents of rural counties.

DATA AND METHODS

The number of Kentucky applicants and matriculants to allopathic medical schools was obtained from the Association of American

Medical College's data warehouse for the five-year period from 2002-2006.⁵ Applicants and matriculants indicated in their American Medical College Application Service (AMCAS) applications their county of residence, which was confirmed by the location of their high school graduation.

CODING THE RURALITY OF COUNTIES

Two coding schema were used to classify the rurality of each of Kentucky's 120 counties. Rural and urban county classifications were determined using the 2003 Rural Urban Continuum Code (RUCC),⁶ which distinguishes metropolitan (metro) counties by the population size of their metro area (codes 1-3), and non-metropolitan (non-metro) counties (codes 4-9) by degree of urbanization and adjacency to a metro area. Based on the RUCC, 85 of Kentucky's counties are designated as rural.

The Index of Relative Rurality (IRR)⁷ was also used to measure the rurality of counties. The IRR is a continuous, multidimensional measure of rurality and is based on four dimensions of rurality: population, population density, extent of urbanized area and distance to the nearest metro area. The index is scaled from 0 to 1, with 0 representing the most urban place, and 1 representing the most rural place. The IRR does not answer the question, "Is a county rural or urban?" but instead addresses the question, "What is a county's degree of rurality?" The IRR was a compelling variable for inclusion in our model of county-level variables because of its being an interval level variable and because it measures more precisely the extent of rurality, with IRR scores ranging from 70% to 20% rural for 119 of Kentucky's counties. Even Jefferson County, the largest and most metropolitan county, has an IRR indicating 10% rurality.

Kentucky has the third most counties of any state, with the counties generally regarded as rural ranging in population from 2,202 to 709,264. The IRR avoids a problem of the RUCC which results in many counties with low population size and low density being allocated to the same category as highly urban counties.

DEMOGRAPHIC VARIANCES

To add context to our description of the rurality of Kentucky's counties, we included information related to the need for physicians, educational preparation and achievements, and income levels aggregated by county. Data were assembled for the following variables: the percent of high school graduates who go to college, median household income, physician-to-population ratio (1:3500) for physicians involved in patient care, total primary care physicians active in patient care, and education in terms of the percent of persons aged 25 or older who completed less than the 9th grade, graduated from high school, and graduated from college. These variables were chosen based on our experience and research findings regarding social and economic forces influencing the number of medical school applicants and matriculants.²

DEVELOPING THE MODEL

These key variables were tested in a least squares multiple regression model using SYSTAT (version 12) for their ability to explain patterns among our 120 counties in the number of both resident applicants and matriculants to medical school. Numerous iterations were made of each model with variables being included and excluded to see which were most explanatory. Some variables were eliminated for being conceptually redundant and others eliminated because they did not correlate with the dependent variable. Finally these variables were selected: the IRR, percentage of high school students going to college, median household income, physician-to-population ratio, and percentage of persons aged 25 or older with a college degree.

Several tests were made of the regression models to assure that the assumptions of linearity, normality, and constant variance were sufficiently met. The Durbin-Watson test for autocorrelation of errors produced acceptable measures for both applicants and matriculants. After transforming the dependent variables by taking their square root, the Lilliefors, Shapiro-Wilk, and Anderson-Darling tests indicated that

both applicant and matriculant data came from sufficiently normal distributions. Plots were made of residuals against predicted values. Counties that were outliers and had strong leverage were removed from the analysis for both applicants and matriculants. This adjustment was necessary given that Kentucky has five counties with large metropolitan populations that tend to have much higher rates of education and income than the 75-80 counties that are strongly rural both in terms of classification by RUCC and degree or rurality as measured by the IRR. This substantially improved the fit of the models. In the end, a total of eight of Kentucky's 120 counties were removed from the analysis. Four of the largest population urban counties (Jefferson, Fayette, Boone, and Kenton) were removed as outliers for both applicants and matriculants and four high income counties that are bedroom communities for these counties were removed because of their large leverage.

RESULTS

The total number of Kentucky applicants to allopathic medical schools for the five-year period was 2,126 of which 1,159 (54.5%) matriculated. A majority of applicants came from urban counties (1,537) compared to rural counties (589). Although more matriculants came from urban (851) than rural counties (308), the matriculant-applicant ratio was similar for both (55.4% vs 52.3%, respectively). Six of Kentucky's 120 counties had no applicants during the study period, and there were no matriculants from 14 counties, all of which were classified as rural counties.

The low number of rural applicants to medical school was highly correlated with the relative rurality of their county of residence, a low physician-to-population ratio and a low number of total primary care physicians (Table 1). The percentage of county residents having a bachelor's degree or higher level of education had a positive impact on the application rate. As expected, a similar pattern was observed among matriculants.

In order to gain insight about particular factors that influence the level of interest of rural

Table 1. Applicants and Matriculants to Kentucky Medical Schools 2003-2006

Model Variables	Applicants		Matriculants	
	Standardized Coefficients Beta	Sig.	Standardized Coefficients Beta	Sig.
Index of Relative Rurality	.053	.032	.042	.068
Percent High School Graduates Going to College	-.011	.470	-.009	.519
Median Household Income	-.008	.791	-.017	.565
Physician-to-Population Ratio	-.053	.003	-.058	.001
Total Primary Care Physicians	.982	.000	.981	.000
Percent Population Completing Less Than 9th Grade	.028	.659	-.006	.919
Percent Population Graduated High School	.030	.696	.003	.969
Percent Population With BA/BS or Higher	.115	.000	.114	.000

Applicants: R = .990, R² = .980, F = .000, D-W = 1.838
 Matriculants: R = .991, R² = .982, F = .000, D-W = 1.953

students in medical school and other health professions, a small cohort of students attending summer health camps at the University of Kentucky was surveyed. Twenty-six of the 28 students completed the survey (average age 16.5). Seventy-six percent of the respondents were female, and the race/ethnicity matched the demography of Kentucky: Caucasian 76%, Asian 12%, African American 8%, and Hispanic 4%. When asked when they first became interested in a health career, 92.3% indicated age 15 or younger. Fathers (65.4%), mothers (77.0%), grandparents (60.0%), friends (77.0%), teachers (92.3%), and school counselors (72.0%) were influential in stimulating their interest in a health career. Several sources of information about the health professions were thought to be helpful, including television (69.3%), school presentations (80.8%), brochures (77.0%), Internet (96.2%), mentoring (61.6%), and volunteering (65.4%). The students had several concerns about pursuing a health career, the most distressful being the cost (96.2%), the length of training (84.6%), and the stress of medical education (73.1%).

DISCUSSION

Previous research has demonstrated that the most important prerequisite for becoming a rural physician is to be from a rural community.^{8,9}

Other indicators that increase the likelihood a physician will practice in a rural community include having been trained in a rural area and selection of family medicine or at least a primary care discipline as a specialty.^{10,11} In order to respond to the health care needs of rural America, public medical schools tend to take more students from rural counties than the number of applicants from those counties would seem to justify.

This study of applicants and matriculants in Kentucky showed that, even though the matriculant-applicant ratio is similar from rural and urban counties, the percentage of applicants from rural counties (27.7%) is low relative to the percent of population (43%) in those areas and the total number of applicants. However, even though more than half of the applicants from rural counties matriculate, this group makes up only 26.6% of the number of matriculants that are Kentucky residents. As expected, the number of rural applicants in this study was highly correlated with the rurality of their county and the local need for primary care physicians. Thus, prospective students respond to their perception of need for physicians.

This study, similar to the report by Long, et al,¹¹ indicates that in order to increase the number of rural students interested in health care careers, an interest in the health sciences and the professions should be fostered at an

early age. Dhalla and colleagues¹² found that medical students were more likely than the general student population to have parents who were highly educated. As shown in this study, rural students are likewise influenced by those who are more highly educated. Counties with more citizens holding bachelor's degrees produced more medical school applicants than counties with fewer citizens with college degrees. Efforts must be made to increase the educational aspirations of prospective students from rural counties. For example, some medical schools have pipeline programs exposing middle and high school students to health careers that increase the number of students going into the health sciences. The ultimate goal of these programs is to inspire students to enter the health professions and to demonstrate that a career in the health professions is both possible and achievable. This study also provides evidence that role models including teachers, school counselors, and family members have a strong influence on a young student's interest in a health career.

In addition to pipeline programs, medical schools should consider several other initiatives to increase the number of rural applicants. Internet sites on health careers are a particularly popular source of information for all students as well as organized opportunities for volunteering and shadowing in their local community. Written materials and school presentations by various health professionals are also important sources of information and can be distributed in science classes. Internet-based information is likely to be helpful, as it was reported as the most used source by summer camp attendees for information on health professions. Health professions "clubs" in the middle and high schools may facilitate these activities.

Many rural students, or students who decide to pursue a career in medicine late in their college experience, may not be prepared for the college-level courses required for medical school. Nevertheless, study findings suggest that rural students who complete the appropriate courses and are admitted to medical school are as academically qualified as non-

rural applicants based on admissions criteria and performance.¹²

The cost of medical education was shown in this study to be a deterrent to potential students, which is consistent with other studies such as that of Rosenthal, et al,¹³ which reported that the cost of additional study and the accumulated debt deters students from pursuing a career in medicine, particularly primary care. However, early aspiration to a career in medicine allows students to plan their curricula to complete both required courses for their degree and medical school prerequisites.

Medical schools in Kentucky and elsewhere have developed programs to encourage students to practice in rural areas, such as regional clinical campuses. In these programs, students complete their first two years of medical training at the main campus and their last two years at a rural site. These remote campuses are used to attract students from rural communities and train them in rural areas so that they will be more likely to become rural physicians. This setting for rural medical education creates an even greater need for rural applicants.

If the current and projected shortage of rural physicians is to be addressed, the number of qualified medical school applicants from rural areas must be increased. The applicant pool of rural students must be increased in order for more students to matriculate to medical school and for more physicians to practice in rural areas. These data support the argument that medical school applicants from rural communities should be considered under-represented in the admissions process. A new medical school accreditation standard by the Liaison Committee on Medical Education¹⁴ might accommodate this position by requiring medical schools to develop programs that "make admission to medical school more accessible to potential applicants of diverse backgrounds."

CONCLUSION

This study of applicants and matriculants in Kentucky showed that, even though the matriculant-applicant ratio is similar from rural

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and urban counties, the percentage of applicants from rural counties (27.7%) is low relative to the percent of population (43%) in those areas and the total number of applicants. However, even though more than half of the applicants from rural counties matriculate, this group makes up only 26.6% of the number of matriculants that are Kentucky residents. As expected, the number of rural applicants in this study was highly correlated with the rurality of their county and the local need for primary care physicians. Prospective students respond to their perception of need for physicians. Rural students are likewise influenced by those who are more highly educated. Counties with more citizens holding bachelor's degrees produced more medical school applicants than counties with fewer citizens with college degrees. To overcome the shortage of physicians in rural communities efforts must be made to increase the educational aspirations of prospective students from rural counties.

REFERENCES

1. Stenger J, Cashman SB, Savageau J. The primary care physician workforce in Massachusetts: implications for the workforce in rural, small town America. *J Rural Health*. 2008; 24(4):375-383.
2. Kentucky Institute of Medicine Comprehensive Statewide Physician Workforce Study. Available at <http://kyiom.org/cspws.html> Accessed February 12, 2009.
3. Council on Graduate Medical Education 16th Report: Physician Workforce Policy Guidelines for the United States, 2000-2020. US Department of Health and Human Services, HRSA, 2005.
4. AAMC Statement on Physician Workforce, June, 2006. Association of American Medical Colleges, Available at <http://www.aamc.org/workforce/workforceposition.pdf>. Accessed February 12, 2009.
5. AAMC Data Book, AAMC Data Warehouse—Applicant/Matriculant. Available at <http://www.aamc.org/data/databook/start.htm>. Accessed July 11, 2008.
6. Measuring Rurality. Available at <http://www.incontext.indiana.edu/2007/january/2.asp>. Accessed February 12, 2009.
7. Measuring Rurality: Rural-Urban Continuum Codes. Available at <http://www.ers.usda.gov/Briefing/Rurality/RuralUrbCon/>. Accessed February 12, 2009.
8. Owen JA, Conaway MR, Bailey BA, Hayden GF. Predicting rural practice using different definitions to classify medical school applicants as having a rural upbringing. *J Rural Health*. 2007;23(2):133-140.
9. Rabinowitz HK, Diamond JJ, Markham FW, Wortman JR. Medical school programs to increase the rural physician supply: a systematic review and projected impact of widespread replication. *Acad Med*. 2008; 83 (3):235-243.
10. Schwartz MF. The physician pipeline to rural and underserved areas in Pennsylvania. *J Rural Health*. 2008;24(4):384-389.
11. Longo DR, Corman RJ, Ce B. Rural medical school applicants: do their academic credentials and admission decisions differ from those of nonrural applicants? *J Rural Health*. 2005; 21(4):346-350.
12. Dhalla IA, Kwong JC, Baddour RE, Waddell AE, Johnson IL. Characteristics of first-year students in Canadian medical schools. *CMAJ*. 2002; 166 (8):1029-1035.
13. Rosenthal MP, Marquette PA, Diamond JJ. Trends along the debt-income axis: implications for medical student's selections of family practice careers. *Acad Med*. 1996;71:675-677.
14. Liaison Committee on Medical Education. Functions and Structure of a Medical School, Standard IS-16. 2008.