Preceptorship Rurality Does Not Affect Medical Students’ Shelf Exam Scores

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Objective: This study’s objective was to determine whether junior medical students’ end-of-rotation shelf exam scores varied by the preceptorship county’s rurality. Methods: Student learning during rural preceptorship experiences, 1999 to 2005, was assessed using the students’ scores on the National Board of Medical Examiners family medicine subject examination. Rurality was measured using both population density and the rural-urban continuum (RUC) codes. Results: Exam scores were collected between January 1999 and May 2005 for 734 students. Mean scores did not vary significantly by rurality, although they did vary significantly by semester. Test scores of students in rural locations were not statistically significantly different from those of students in urban preceptorships. Conclusions: Students assigned to preceptorships in rural locations scored at the same levels as students in urban preceptorships. The finding that there were no differences in medical students’ exam scores based on the rurality of their family medicine preceptorship site indicates a substantial degree of educational equivalency between urban and rural preceptorships.

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Many medical schools seek to place students in rural sites for a family medicine clerkship. Family medicine faculty and a solid majority of medical students feel that a medical student’s clinical education in family medicine is enhanced by student rotations at remote sites.1-9

Recently, however, issues of educational equity have been raised. While there is a body of evidence that supports the educational value of rural preceptorship experiences from both the student and institutional perspectives, there is relatively little evidence to address concerns about the influence the family medicine rotation’s location has on equity of learning. Some medical school administrators are concerned about the educational experience for students in more-rural communities because of the lack of immediate on-site specialty physician consultation and other services more readily available in larger communities. The Liaison Committee on Medical Education (LCME) also has concerns about the “educational equivalency” of community sites for medical student rotations and asks accredited medical schools to monitor and assure such equivalency.10

Students tend to rate rural and community-based rotations higher than urban and university rotations.1,3,6,8 Our students have indicated that they enjoy the clinical rotation primarily because it provides a “real world” experience, one-on-one learning with a clinician, and the chance to apply what they have learned to evaluate and treat common clinical problems. This is consistent with the findings from other evaluations of what students value about primary care clinical experiences.11

From the institutional perspective, early preceptorship experiences are valued both for the education outcomes and, in the United States,12 increasing the rural supply of physicians. Research has demonstrated that the educational benefits include basic clinical skills, specific skill areas (such as preventive health care skills and care for patients with chronic health problems), and professional socialization.2,4,9,12

Our literature search revealed few studies that have examined the effect of preceptorship location on students’ learning. Those that exist suggest that, on a rural versus urban level, there is little difference in clinical content or teaching quality.1 One recent study indicated that changes in medical students’ perceived learning
during an 8-week rural family medicine preceptorship was not affected by degree of rurality of the preceptorship site. Our literature searches have revealed no published studies, however, that have examined objective measures of students’ learning at preceptorship sites controlled for degree of rurality.

Our present study examined the effect of rurality of family medicine preceptorship locations on junior (M3) students’ performance on the National Board of Medical Examiners (NBME)’s standardized Family Medicine Examination (shelf exam). As in many clinical rotations, this family medicine preceptorship takes place via a distributive model, with students placed with rural, urban, or suburban family physicians or in family medicine residency programs. Because of this, assuring the “educational equivalency” of clinical preceptorship sites is important for family medicine educators and course administrators. The family medicine shelf exam is used at many medical schools to assess end-of-rotation knowledge, and we used it for this purpose in our study.

**Methods**

We tested the null hypothesis that rurality of family medicine preceptorship locations does not affect the students’ shelf exam scores. Institutional Review Board approval was obtained to use exam data for this study.

**Overview**

The University of Nebraska Department of Family Medicine has required a family medicine 8-week rural preceptorship for M3 medical students since 1971. The preceptorship is governed by a preceptorship committee, appointed by the dean of the College of Medicine. All applications for physicians to become preceptors are reviewed by the committee against standard criteria. All preceptor sites are staffed by board-certified family physicians and offer students a full scope of practice, including delivery of babies. The preceptorship educational experience is reviewed on a site-by-site basis by the preceptorship committee to ensure adequate and equivalent educational experience for students.

Data were collected between January 1999 and May 2005. Most of the students were assigned to rural family physician preceptors in Nebraska communities with populations ranging from 1,100 to 45,000. In addition, some students with exceptional circumstances were permitted to complete this rotation in the Omaha area (population 309,000). Students at all sites completed the NBME standardized Family Medicine Examination (shelf exam) during the final week of the preceptorship.

**Instruments**

The NBME shelf exam is a standardized national clinical science examination. The examination takes 2 hours and 10 minutes to administer and is graded by the NBME. A full description of the test and testing procedures can be found at the NBME Web site. We recorded shelf exam results along with preceptorship location and the students’ gender and hometown population.

Degree of rurality was measured in two ways: rural-urban continuum (RUC) codes and population density. The RUC codes combine total county population and adjacency to a metropolitan area to form a categorical classification system. This results in a system with nine categories, with “9” being the most rural, “Completely rural or less than 2,500 urban population, not adjacent to a metro area.” Two of the RUC codes were not applicable to our data (counties in metro areas of 1 million population or more and counties in metro areas of <250,000 population).

Population density was measured as persons per square mile for the county in which the preceptor’s office is located, based on the 2000 data from the US Census Bureau. In cases where these data were not available, such as unincorporated areas, we used the best information available. We used population density as a measuring tool because it is a continuous measure and therefore allows differentiation of our most rural counties. In the case of our state, nearly 52% of the 93 counties were in RUC code 9, the most rural category. Of those RUC code 9 counties, the lowest population was 444 and the highest was 9,615.

**Analyses**

All analyses were conducted using SPSS 12.0.0. Analyses of variance (ANOVAs) were used to determine whether the average test scores differed across gender and to determine if there was an interaction between RUC codes and semester of study. Multiple regression analysis was used to investigate the combined effect of gender, semester, and population density on test scores.

**Results**

A total of 640 completed sets of data were available for the primary analysis; 62 cases were unsuitable for analysis due to missing test score information. There were no statistically significant differences between the cases with missing information and the rest of the sample. Contrary to findings in prior research, which suggest there might be learning differences by gender, we found no gender differences on the test scores. During the period 1999–2005, 80% of the 640 students completing the test rotated at rural sites (RUC codes 4 to 9; see Table 1). The average test score was 77 (SD=7.45).
As expected, there was a main effect for semester (F=94.46, \( P<.001 \)). Average shelf exam scores were higher for those who took their rotation during second semester (80.68, standard error [SE]=.49) than for those who took their rotation first semester (74.19, SE=.45).

Shelf exam scores did not vary by rurality of the preceptorship. There was not a significant difference on average test scores across the RUC codes (F=1.397, \( P=.213 \)), nor was there a significant interaction between rural/urban location and semester of rotation on average test scores (F=.005, \( P=.944 \)).

The regression model revealed that semester was the only variable to contribute significantly to test scores (\( t=12.2, P<.001 \)), confirming that those with more educational experience prior to completing their rotation scored higher on the exam. The overall model explained 19% of the variance in test scores.

Discussion
Our analysis based on the rurality of the family medicine preceptorship site indicates a substantial degree of educational equivalency between rural and urban preceptorships in terms of students’ knowledge after the preceptorship. Our results have two important implications for medical education. First, our results suggest that residency program directors can send students to rural areas without concern about degradation of educational quality as measured by shelf exam scores. Including rural preceptors increases the supply of family medicine educators available when scheduling rotations.

Second, our results suggest that programs whose mission includes meeting the needs of underserved rural populations can readily consider using rural preceptorship experiences as a means of increasing student exposure to rural practice opportunities. Greater exposure to rural rotations in training may lead more medical students to consider careers as rural physicians.18

There are several areas in which we would like to see this research expanded. One obvious limitation of this study is that the data are from a single medical school. Characteristics of our school that might influence the results are that 80% of our students have rural rotations, and our preceptors may somehow differ from preceptors in other medical schools. In addition, it is possible

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Table 1
RUC Codes and Shelf Exam Scores by Semester

<table>
<thead>
<tr>
<th>RUC Code</th>
<th>Description</th>
<th>n</th>
<th>Total %</th>
<th>Test Average</th>
<th>Semester</th>
<th>n</th>
<th>Test Average</th>
<th>Minimum Test Score</th>
<th>Maximum Test Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Counties in metro areas of 1 million population +</td>
<td>0</td>
<td>0.0</td>
<td>1</td>
<td>71</td>
<td>5</td>
<td>73.1</td>
<td>57</td>
<td>90</td>
</tr>
<tr>
<td>2</td>
<td>Counties in metro areas of 250,000–1 million population</td>
<td>128</td>
<td>20.0</td>
<td>77.7</td>
<td>1</td>
<td>70</td>
<td>74.5</td>
<td>61</td>
<td>102</td>
</tr>
<tr>
<td>3</td>
<td>Counties in metro areas of &lt;250,000 population</td>
<td>0</td>
<td>0.0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>78.5</td>
<td>68</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>Urban population of 20,000+, adjacent to a metro area</td>
<td>48</td>
<td>7.5</td>
<td>75.8</td>
<td>1</td>
<td>25</td>
<td>73.1</td>
<td>61</td>
<td>90</td>
</tr>
<tr>
<td>5</td>
<td>Urban population of 20,000+, not adjacent to a metro area</td>
<td>109</td>
<td>17.0</td>
<td>76.9</td>
<td>1</td>
<td>64</td>
<td>73.1</td>
<td>61</td>
<td>90</td>
</tr>
<tr>
<td>6</td>
<td>Urban population of 2,500–19,000, adjacent to a metro area</td>
<td>48</td>
<td>7.5</td>
<td>78.6</td>
<td>1</td>
<td>23</td>
<td>74.8</td>
<td>61</td>
<td>90</td>
</tr>
<tr>
<td>7</td>
<td>Urban population of 2,500–19,000, not adjacent to a metro area</td>
<td>224</td>
<td>35.0</td>
<td>77.5</td>
<td>1</td>
<td>117</td>
<td>74.1</td>
<td>61</td>
<td>90</td>
</tr>
<tr>
<td>8</td>
<td>Completely rural or &lt;2,500 urban population, adjacent to a metro area</td>
<td>35</td>
<td>5.5</td>
<td>76.2</td>
<td>1</td>
<td>20</td>
<td>73.5</td>
<td>61</td>
<td>90</td>
</tr>
<tr>
<td>9</td>
<td>Completely rural or &lt;2,500 urban population, not adjacent to metro area</td>
<td>48</td>
<td>7.5</td>
<td>76.4</td>
<td>1</td>
<td>29</td>
<td>73.5</td>
<td>61</td>
<td>90</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>640</td>
<td>100.0</td>
<td>77.0</td>
<td></td>
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</table>

RUC—rural-urban continuum
that those students who end up in urban areas might start off with lower skill sets, masking any differential increase in learning. We hope that other schools will replicate this study to ensure that these characteristics do not have an impact.

Another limitation of this study is that we have used the shelf exam as our measure of educational attainment. The family medicine shelf exam is currently used by slightly more than 50% of medical schools offering rotations in family medicine. While this is the measure by which we evaluate our students, it has been criticized as a measurement tool because it is a measure of content learned during the preceptorship. Further research examining the effect of rural site on student learning as measured by other testing modalities would be valuable.

Conclusions

As educators, we want to excite our students about the field of family medicine and expose them to opportunities for practical application of their newly learned knowledge and skills. As an institution, we need to meet our mission to provide physicians interested in practicing throughout our rural state. We also need to know how well our students are learning the course content and to use evaluation methods that are fair.

Sending students to preceptorship sites provides both opportunities and the chance to excite them about our field. Research has shown that rural clinical experiences are a useful tool in influencing students to practice in rural areas after graduation. Such a distributive learning model also, however, challenges us to assure the “educational equivalency” of clinical preceptorship sites. Our study of the testing convinced us that our students who complete their preceptorships at more-rural sites enjoy educational equivalency, as measured by the shelf exam, with students at more-urban preceptor sites.

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References