A Comparison of Urban and Rural Medical Student's Academic Performance and Rural Retention in Nevada — UME Graduates 2005-2014

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Key Findings

- When comparing rural and urban students who have attended UNR Med, there was no statistically significant difference between the student's demographics, state of birth, state of high school, state of undergraduate degree, preferred state, practice in primary care, undergraduate degree GPA, and MCAT scores.
- A statistically significant greater proportion of rural students were practicing in rural counties in Nevada when compared to urban students.
- Rural students admitted to UNR Med UME program from 2005 to 2014 had a 1,162% increase in the odds of practicing in rural counties in Nevada compared to urban students.

Introduction

Within the rural physician retention literature, it has been found that rural students are more likely to locate to a rural community to practice medicine after their medical training completion.[1-13] However, this finding has not been explored in the graduates of the University of Nevada, Reno School of Medicine Undergraduate Medical Education (UNR Med UME) program. The purpose of this study is to examine the rural and urban UME students who have attended UNR Med from 2005 to 2014. This report compares rural and urban student's demographics, previous locations, undergraduate's degree grade point average (GPA), and medical college admission test (MCAT) scores. This study also examines students who were working in rural and urban

counties in Nevada and calculates the odds ratio of rural medical students practicing in rural counties in Nevada when compared to urban medical students.

Methods

A retrospective review of historical data was performed for nine years of the UNR Med UME graduates, classes 2005 to 2014, comparing the rural and urban student's characteristics. The 2007 graduating class were excluded from this study due to data quality issues. Graduates without active medical licenses at the time of data collection were excluded from this study.

Data were obtained from:

Study Variables	Data Sources
Age, Gender, Race, Marital Status, Rural Status, Disadvantaged Status, Birth State, High School State, Undergraduate Degree State, Undergraduate GPA, MCAT Scores	UNR Med Office of Student Affairs student records
Preferred State	UNR Med Alumni Association
Residency State, Practice Location, Specialty Training	Google, Sharecare, social media (LinkedIn), institutional websites, medical practice websites

The Institutional Review Board approval for the study was received from the University of Nevada, Reno (1223968-1).

Age at admission was categorized as less than 23 years of age, 24-25 years of age, and 26 years of age or older. Gender was categorized as male or female. The race variable categories were White, Asian, and third category that included African

American, Hispanic, Native American, Alaskan, and Hawaiian. Due to the low counts for the races African American, Hispanic, Native American, Alaskan, and Hawaiian were combined to increase statistical power for analysis. Marital status was self-reported at admission. The AAMC defined rural status as students who lived in a rural location for six months or graduated from a rural high school or were born in a rural location.[14] The AAMC defined disadvantaged status as students with low SES or first-generation college students.[14] Low SES was defined as students whose parents work in service, clerical, skilled and unskilled labor, or students with deceased parents, or students with no parental information.[14] Preferred states locations were self-reported to the UNR Med Alumni Association at the student's UME completion. Birth state, state of high school graduation, state of undergraduate degree completion, preferred state, and residency state were separated into four categories using the U.S. Census Regions (supplemental table).[15] Birth state contained a fifth category for those born outside of the U.S. called internationally born. Residency state for this study was the location of the graduate's first residency after UME completion. Undergraduate college state is the state the graduates received their bachelor's degree. MCAT verbal reasoning (VR) and MCAT physical science (PS) scores were separated into two categories high (≥9) and low (≤8). MCAT biological science (BS) scores were also separated into two categories high (≥10) and low (≤9). MCAT writing sample (WS) was categorized into two groups. The first group included scores J, K, L, M, N, and O as the low scores, and the second group included scores P, Q, R, S, and T for the high scores. MCAT WS score has an

alphabetic scale ranging from J (lowest) to T (highest).[16] Current medical practice was categorized into two groups (primary care and all other specialists) using definitions from the American Board of Medical Specialties (ABMS) (supplemental table). [17] Undergraduate GPA was separated into two categories high (≥ 3.67) and low (≤ 3.66).

The data were analyzed using SAS 9.4 (SAS Institute Inc., Cary, NC). For the bivariate analysis, chi-square was used to compare the proportions and characteristics between rural and urban students, as well as a subset analysis comparing the likelihood of practicing in a rural location between rural students and urban students. The chi-square test was restricted to non-missing. A two-sided t-test was utilized to compare the academic history means between rural and urban students. To analyze the MCAT WS scores, numerical values were assigned to the character scores J-T. J was given a numerical value of 1 being the lowest possible score, and T was given the numerical value of 11 being the highest possible score. This allowed for a two-sided t-test to compare means between groups. The unadjusted odds ratio, confidence intervals, and p-values for rural and urban students were calculated using the Cochran–Mantel-Haenszel statistic. Significance was assessed at $P<0.05$.

Results

The dataset included 533 graduates, and of these graduates, 438 met the criteria for inclusion. Of the 438 UNR Med UME graduates included in this study, 49 of the graduates were classified as rural students, and 389 were classified as urban students

upon admission. Table 1 displays the demographic characteristics of UNR Med UME rural and urban students. There is no statistically significant difference in age, gender, race, marital status, and disadvantaged status between rural and urban students.

Table 1. Demographic Characteristics of the UNR Med UME Rural and Urban Students From Classes 2005-2014

Characteristics	Rural Students n=49		Urban Students n=389		X^2 (d.f.)*	p-value
Age at Admission						
26 or older	13	26.5%	75	19.3%		
25-24	24	49.0%	173	44.5%		
23 or Younger	12	24.5%	141	36.3%	3.0572 (3)	0.2168
Missing	0		0			
Gender						
Female	24	49.0%	183	47.2%		
Male	25	51.0%	205	52.8%	0.0575 (1)	0.8106
Missing	0		1			
Race						
White	36	78.3%	264	70.6%		
Asian	6	13.0%	87	23.3%		
Other	4	8.7%	23	6.2%	2.6822 (2)	0.2616
Missing	3		15			
Marital Status						
Single	39	86.7%	324	86.6%		
Married	6	13.3%	50	13.4%	0.0000 (1)	0.9947
Missing	4		15			
Disadvantaged Students						
Yes	5	10.2%	33	8.6%		
No	44	89.8%	351	91.4%	0.1408 (1)	0.7075
Missing	0		5			

† C.I. Confidence interval 95%
* Chi-square test, d.f. = degrees of freedom
‡ Chi-square test excludes missing data
Excludes 2007 Graduating Class

Table 2 displays the previous state locations of the UNR Med UME graduates. The previous locations are similar between rural and urban students, and there is no statistical difference between rural and urban student's birth state, high school state, undergraduate degree state, preferred state, and primary care practice.

Table 2. Previous Locations the UNR Med UME Rural and Urban Students From Classes 2005-2014

Characteristics	Rural Students n=49		Urban Students n=389		X^2 (d.f.)*	p-value
Birth State						
Nevada	14	28.6%	137	35.7%		
California	11	22.5%	69	18.0%		
Other Western States	11	22.5%	67	17.5%		
Midwestern, Northeastern, Southern States	11	22.5%	59	15.4%		
Internationally Born	2	4.1%	52	13.5%	6.1720 (4)	0.1867
Missing	0		5			
High School State						
Nevada	34	69.4%	301	78.8%		
California	4	8.2%	28	7.3%		
Other Western States	8	16.3%	34	8.9%		
Midwestern, Northeastern, Southern States	3	6.1%	19	5.0%	3.1051 (3)	0.3757
Missing	0		7			
Undergraduate Degree State						
Nevada	24	49.0%	218	56.2%		
California	6	12.2%	58	15.0%		
Other Western States	15	30.6%	61	15.7%		
Midwestern, Northeastern, Southern States	4	8.2%	51	13.1%	7.0295 (3)	0.071
Missing	0		1			
Preferred State						
Nevada	21	42.9%	172	45.0%		

California	5	10.2%	52	13.6%		
Other Western States	14	28.6%	82	21.5%		
Midwestern, Northeastern, Southern States	9	18.4%	76	19.9%	1.4630 (3)	0.6908
Missing	0		7			
Residency Training State						
Nevada	14	33.3%	74	21.1%		
California	5	11.9%	71	20.3%		
Other Western States	14	33.3%	91	26.0%		
Midwestern, Northeastern, Southern States	9	21.4%	114	32.6%	6.0778 (3)	0.1079
Missing	7		39			
Current Medical Practice						
Primary Care	12	24.5%	117	30.1%		
All Other Specialist	37	75.5%	272	69.9%	0.6539 (1)	0.4187
Missing	0					

† C.I. Confidence interval 95%
* Chi-square test, d.f. = degrees of freedom
‡ Chi-square test excludes missing data
Excludes 2007 Graduating Class

Table 3 is a comparison of undergraduate degree GPA and MCAT scores between rural and urban students admitted to UNR Med. Again, there is no statistical difference between rural and urban students scoring high or low on the MCAT test or having a high or low undergraduate degree GPA.

Table 3. Academic Comparison of the UNR Med UME Rural and Urban Students Classes 2005-2014

Characteristics	Rural Students n=49		Urban Students n=389		X^2 (d.f.)*	p-value
MCAT: Verbal Reasoning (VR) Score (Max 15)						
High, <=9	24	49.0%	202	51.9%		
Low, >9	25	51.0%	187	48.1%	0.1515 (1)	0.6971
MCAT: Physical Science (PS) Score (Max 15)						
High, <=9	32	65.3%	205	52.7%		
Low, >9	17	34.7%	184	47.3%	2.7854 (1)	0.0951
MCAT: Biological Science (BS) Score (Max 15)						
High, <=10	34	69.4%	234	60.2%		
Low, >10	15	30.6%	155	39.9%	1.5623 (1)	0.2113
MCAT: Writing Sample (WS) Score (Max T)						
High - P, Q, R, S, T	26	53.1%	177	45.6%		
Low - J, K, L, M, N, O	23	46.9%	211	54.4%	0.9688(1)‡	0.3250‡
Missing			1			
Undergraduate Degree GPA Mean (Out of 4.0)						
High, <=3.67	27	55.1%	198	50.9%		
Low, > 3.67	22	44.9%	191	49.1%	0.6270 (1)	0.4284‡

† C.I. Confidence interval 95%
* Chi-square test, d.f. = degrees of freedom
‡ Chi-square test excludes missing data
Excludes 2007 Graduating Class

Table 4 is a comparison of the average undergraduate degree GPA and MCAT scores between rural and urban students. Again, the averages score are similar between the two groups.

Table 4. Academic History Comparison of the UNR Med UME Rural and Urban Students Classes 2005-2014

Academic History	Rural Students n=49			Urban Students n=389			
	Mean**	95% C.I.†	SD	Mean**	95% C.I.†	SD	p-value
Undergraduate Degree GPA Mean (out of 4.0)	3.64	(3.6-3.7)	0.27	3.64	(3.6-3.7)	0.26	0.9982
MCAT VR Mean (Max 15)	9.57	(9.1-10.1)	1.68	9.38	(9.2-9.5)	1.60	0.4285
MCAT PS Mean (Max 15)	9.12	(8.7-9.6)	1.51	9.48	(9.3-9.6)	1.62	0.1386
MCAT BS Mean (Max 15)	9.88	(9.4-10.3)	1.54	10.26	(10.1-10.4)	1.41	0.0774
MCAT WS Mean (Max 11)	6.35	(5.8-2.6)	2.08	6.36	(6.2-6.5)	1.89	0.9686

† C.I. Confidence interval 95%
** Two-sided T-test
MCAT WS Score 6=O
Excludes 2007 Graduating Class

Table 5 displays the graduates with active medical licenses in rural and urban counties in Nevada in comparison to rural and urban student status. Of the 169 graduates with active medical licenses in Nevada, seven were practicing in rural counties, and 162 were practicing in urban counties. Of the seven graduates practicing in rural counties, 4 (57.1%) were also rural students, and 3 (42.9%) were urban students. Of the 162 graduates practicing in urban counties, 15 (9.6%) were rural students and 142 (90.5%) were urban students. Rural student status was statistically different between graduates practicing in rural counties and graduates practicing in urban counties in Nevada. More of the proportion of UNR Med UME students who were classified as rural student status (57.1%) upon admission, were practicing medicine in

rural counties in Nevada compared to urban student's proportions (9.6%) practicing in rural counties.

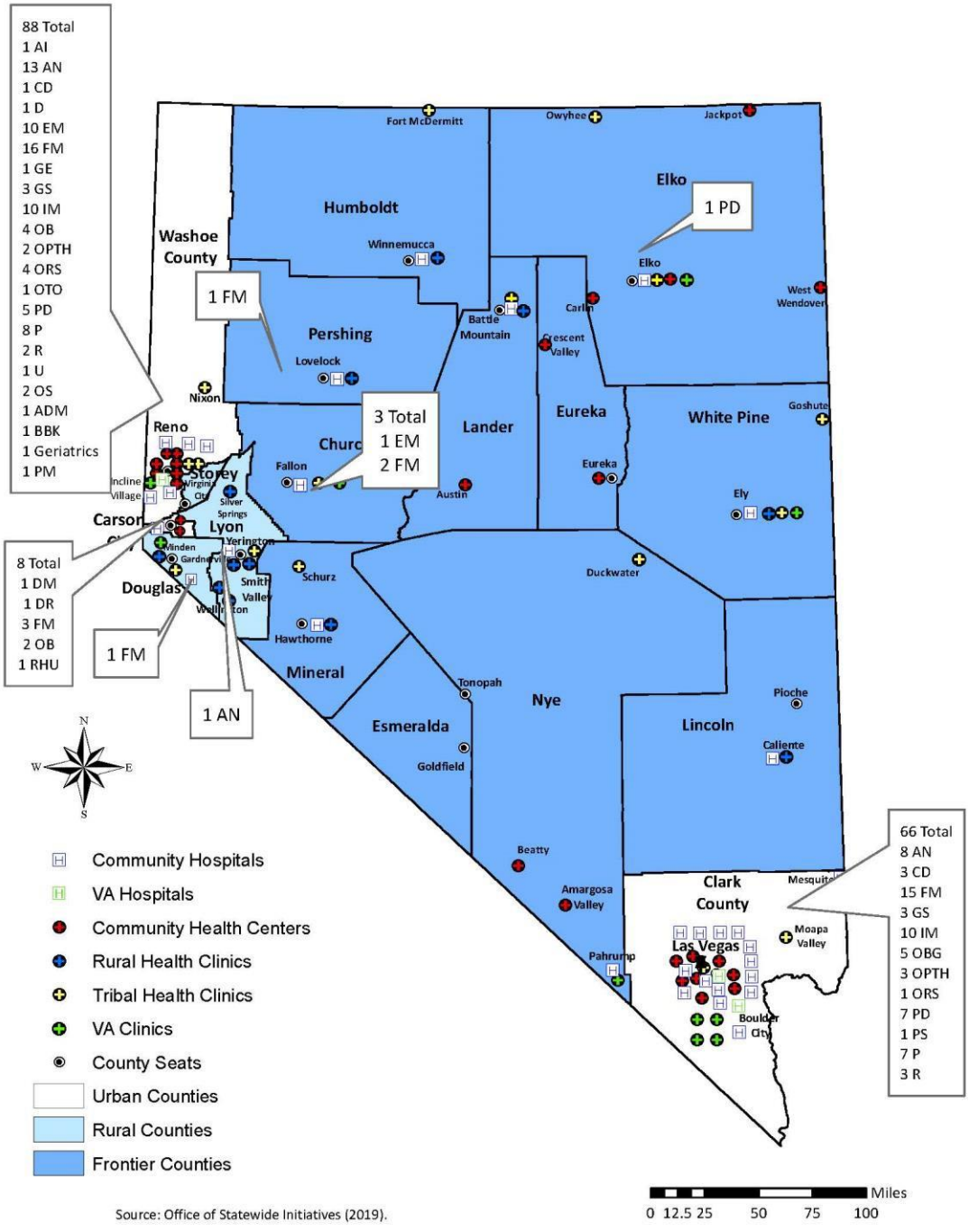
Table 5. Rural and Urban Students with Active Medical Licenses in Rural and Urban Counties in Nevada

Characteristic	Practicing in Nevada's Rural Counties		Practicing in Nevada's Urban Counties			
	n=7		n=162		X^2 (d.f.)*	p-value
Rural Student Status	4	57.1%	15	9.6%		
Urban Student Status	3	42.9%	142	90.5%	14.8159 (1)‡	0.0001
Missing Status	1		19			

† C.I. Confidence interval 95%
* Chi-square test, d.f. = degrees of freedom
‡ Chi-square test excludes missing data
Excludes 2007 Graduating Class

Below is a map that displays the county locations and practice type of the UNR Med UME graduating classes from 2005 to 2014 who are practicing in Nevada. The blue on the map indicated the rural or frontier counties: Churchill, Douglas, Elko, Esmeralda, Eureka, Humboldt, Lander, Lincoln, Lyon, Mineral, Nye, Pershing, Storey, and White Pine. The white indicates the urban counties: Carson City, Clark, and Washoe. The majority of the graduates practicing in Nevada were located in Washoe County with a total of 88 physicians, followed by Clark County with a total of 66 physicians, and Carson City with eight physicians. Examining the rural counties, Churchill had a total of three physicians, followed by Douglas, Elko, Lyon, and Pershing with one physician practicing in each county.

Map 1: UNR Med UME 2005-2014 Graduates
Active Medical License Locations and Practice Type in Nevada



Source: Office of Statewide Initiatives (2019).

Table 6 displays the unadjusted odds ratio for rural students practicing in a rural county in Nevada compared to urban students. Graduates who were classified as rural students upon admission (OR 12.62 [95% CI 2.58-61.82]), had a statistically significant higher odds of practicing in a rural county in Nevada compared to graduates who were classified as urban students upon admission. Using the percent relative effect interpretation, rural students admitted to UNR Med UME program from 2005 to 2014 had a 1,162% increase in the odds of practicing in rural counties in Nevada compared to urban students.

Table 6.Unadjusted Odds Ratio of Rural Students Practicing in a Rural Counties in Nevada UNR Med UME Classes 2005-2014

	Unadjusted Odds Ratio	95% C.I.†	p-value
Rural Student Status			
Yes	12.62	(2.58-61.82)	
No (Reference)	1.00	---	0.0001

† 95 % C.I. Confidence interval
Excludes 2007 Graduating Class

Discussion

This report examines the characteristics of rural and urban students admitted into the UNR Med UME program from 2005 to 2014. The variables of interest included age at admission, gender, race, marital status, rural status, disadvantaged status, birth state, state of high school graduation, state of undergraduate degree completion,

preferred state, state of residency training, current medical practice, undergraduate's GPA, and MCAT scores. This report found rural and urban student's characteristics to be similar in demographics, birth state, high school state, undergraduate degree state, preferred state, primary care, GPA, and MCAT scores. This report also found more of the proportion of rural students were practicing in rural counties compared to urban students, and rural students were much more likely to practice in rural counties compared to urban students. These findings are consistent with previous rural physician retention literature.[1-13] However, there are some limitations to the findings in this report.

The student records obtained from the medical school were not gathered for research purposes, and this may pose problems when interpreting the results of this report. For example, all of the records used in the study were of students accepted into the UNR Med UME program, and the records of students not accepted into the medical school were not used in this report. Therefore, this study may suffer from selection bias. Further, the rigorous nature of the medical school admission process may also influence the findings of this report. It is possible rural students may underperform compared to urban students and were not accepted into UNR Med and were not included in this study; however, this principle also applies to urban students. Using the records of students admitted to UNR Med for this report has shown that both rural and urban students are held to the same strict criteria on their medical school applications, meaning one group is not favored for admission over the other.

The findings on rural students practicing in rural counties in Nevada warrant cautious interpretation due to low counts of rural students and graduates practicing in rural counties. Only 49 students were classified as rural students upon admission to UNR Med, and of those, only four students were practicing in a rural county. Due to the small number of graduates practicing in rural counties and the low number of rural students admitted to UNR Med, the association between rural student status and practicing in a rural county may be inflated. It is possible that if more students were classified as rural students and more students were practicing in rural counties, these findings would be less pronounced. Nonetheless, our data suggest a strong association between rural background and practicing in rural counties and agrees with existing physician retention literature.

Conclusion

Rural students admitted to UNR Med UME program do not differ when compared to urban student's demographics, previous locations, undergraduate degree academic performance, and MCAT scoring. Examining the practice location of the UNR Med UME graduates in Nevada, we found the majority were practicing in urban counties with only seven practicing in rural counties. However, more of the proportion of rural students were practicing medicine in rural counties of Nevada compare to urban students, and rural students were much more likely to practice medicine in rural counties in Nevada when compared to urban students.

Sources

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Appendices 1.

State categorization for the birth state, high school state, undergraduate degree state, preferred state, residency training state are as follows.

Other western states include: Alaska, Arizona, Colorado, Hawaii, Washington, Montana, New Mexico, Wyoming, Utah, Idaho, and Oregon

Midwestern, northeastern and southern states include: North Dakota, South Dakota, Nebraska, Kansas, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Ohio, Michigan, Indiana, Pennsylvania, New Jersey, New York, Connecticut, Maine, Massachusetts, New Hampshire, Oklahoma, Texas, Vermont, Rhode Island, Arkansas, Louisiana, Alabama, Mississippi, Tennessee, Kentucky, Virginia, Washington DC, West Virginia, Maryland, Delaware, North Carolina, South Carolina, Florida, and Georgia.

Appendices 2.

Current medical practice specialty is categorized as follows: Primary care is defined as physicians practicing in general internal medicine, family medicine, general pediatrics, and geriatrics.

Other specialist are defined as physicians practicing in: sports medicine, cardiovascular disease, rheumatology, infectious diseases, family medicine hospitalist, internal medicine hospitalist, gastroenterology, endocrinology, nephrology, pediatrics neonatal perinatal, pediatric cardiology, pediatrics emergency medicine, pediatrics endocrinology, pediatric oncology, pediatrics pulmonary, pediatrics sports medicine, and pediatrics infectious diseases and, all other practices outside of primary care.

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