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Physician demographics were examined to determine if female osteopaths differ in choice of practice specialty and location in Texas. Taken relative to gender and medical degree type female osteopaths have the highest rate of primary care practice, with over 70% engaged in family or general practice, internal medicine, or pediatrics. Female osteopaths have an odds ratio 4 times greater than other physicians to practice primary care. Female osteopaths are also 2.5 times likelier than female allopaths to practice rural primary care. Male osteopaths are 2.3 times likelier than other physicians to practice rural primary care. Primary care osteopaths are 1.4 times likelier to practice rural primary care than allopaths. Policy intended to produce primary or rural primary care physicians should encourage medical school candidates to consider osteopathy.

OSTEOPATHIC PHYSICIANS IN PRIMARY CARE, TEXAS, 2003

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CHAPTER I

INTRODUCTION

The Problem and Purpose

In this study the differences in allopathic physicians (MDs) and osteopathic physicians (DOs) in their choice of specialty type and location are examined. The major issue explored is that of differences between female osteopathic physicians and other physician subtypes. The hypothesis tested is that there are statistically significant differences between female osteopathic physicians and other physicians in their choices of practice specialty and location.

Significance of the Problem

Osteopathic physicians comprise a small but significant portion of the nation's physician supply. DOs are represented in two areas identified as priorities by policymakers: primary care fields and rural healthcare (Council on Graduate Medical Education [COGME], 1998; American Osteopathic Organization [AOA] Online, 2003). The number of women entering medicine is increasing, and their share in the total physician supply reflects the increase (COGME, 1998). Men and women tend to have differences in their selection of specialty and practice site. Women physicians are less likely to select rural practice locations, and are more likely than men to practice in primary care fields (COGME, 1998; COGME, 2003; Hart, Salsberg, Phillips, & Lishner, 2002; Brooks, Salsberg, Phillips, & Lishner, 2002; West, Norris, Gore, Baldwin, & Hart,

1996; Simpson & Weiser, 1996). The trend of an increasing share of the primary care physician supply being women may suggest that rural physician supply will decrease.

Osteopathic medical schools produce a greater proportion of primary care physicians, and the number of female medical students in osteopathic colleges of medicine is growing steadily (Hart et al., 2002). This study of whether female DOs differ significantly from their counterparts in the rate at which they choose practice specialties and characteristics will allow public policy makers to consider the merits of encouraging production of female DOs. Such policies may address key issues in physician supply.

Background

Production of primary care and rural primary care physicians is an area of concern to health policy makers. Significant resources are devoted to encouraging new doctors to train in and practice primary care specialties, and strong measures have been considered to boost the relative numbers of primary care physicians (COGME, 2000; Pew Health Professions Commission, 1995). Primary care and other physicians are also encouraged to practice medicine in rural areas (National Rural Health Association [NRHA], 2003).

In spite of policy makers awareness and efforts, needs in these two areas remain unmet (Longest, 1998; Rabinowitz, Diamond, Markham, & Paynter, 2001, COGME, 2000). Although almost 20% of the US population lives in rural areas (over 50,000,000 people) only 9% of the United States' physician supply is located in such areas (Geyman, 2000, NRHA, 1998). Geyman (2000) and his colleagues noted that in 1998 more than 22 million Americans lived in areas classified as health profession shortage areas (HPSAs),

where there is less than 1 primary care physician per 3500 population, or 28 per 100,000. COGME noted in 2000 that its preferred ratio of generalist to population is 60 per 100,000, although present levels are below that (COGME, 2000).

Issues in Rural Medical Practice

The trend away from practice in rural areas has been present since the early 1950s. In 2002, over 87% of the doctors in the United States practiced in metropolitan areas (American Medical Association [AMA], 2001). At the same time, almost three-quarters of all general/family physicians practice in metropolitan areas (AMA, 2001; Ricketts, 2000). In the twenty years between 1975 and 1995 new graduates of family practice residencies who located in rural areas dropped 60.5%. The Rural Medicine Educators Group of the National Rural Health Association estimates that new entries into rural medicine do not keep up with numbers retiring or leaving practice (Geyman, Hart, Norris, Coombs, & Lishner, 2000; Feldman, 2002). Generalists are most likely to select rural practice—COGME named specialty choice—namely family practice--as the most powerful predictor of rural practice location (Hart et al., 2002, NRHA, 2003, Rabinowitz et al., 2001).

Relative to allopathic medicine, osteopathic medicine appears to be having some measurable success in placing doctors in rural areas (Hart et al., 2002; Frenzen, 1991; Fryer, 1997; NRHA, 1998; Rosenblatt, 1992; Simpson & Simpson, 1994). Osteopathy is a branch of medical education that distinguishes itself through an emphasis on treating disease by a combination of common medical interventions and specific osteopathic treatments. These are based on the theory that human health is function of interrelated

physiology that can be "manipulated" to optimize health or treat disease (AOA, 2003). In osteopathic colleges of medicine these "osteopathic manipulation techniques" are taught alongside a standard medical college curriculum (AOA, 2003; Howell, 1999). In actual practice, little distinguishes osteopathic physicians from their allopathic counterparts, and both are accepted without prejudice by most consumers and all licensing entities (AOA, 2003; Howell, 1999).

In general osteopathic physicians tend toward primary care careers relatively more frequently than allopathic physicians (Hart et al., 2002; Fryer, 1997; NRHA, 1998; Rosenblatt, 1992). Almost half of DOs choose family or general practice careers, while only one in ten MDs do likewise (Hart et al., 2002).

This leads to greater relative numbers of DOs locating and remaining in rural areas (Hart et al., 2002). A study found Colorado DOs were relatively more concentrated in rural areas than in metropolitan practices (Fryer, Stine, Vojir, & Miller, 1997). Hart and his colleagues (2002) found that 18.1% of DOs versus 11.5% of MDs locate and remain in rural areas. Although osteopaths comprise only 5.1% percent of the nation's overall physician supply, they account for 15.3% of all physicians in small rural counties (NRHA, 1998; Simpson & Simpson, 1994).

International Medical Graduates (IMGs) have been relied on to some extent to ease the undersupply of primary care and rural physicians. Subsequent studies have failed to support this contention since IMGs seem to be influenced by the same factors to relocate in metropolitan areas as any other physician (Hilsenrath, Lykens, & Mains, 2003; Fink, Phillips, Jr., Fryer, & Koehn, 2003). After the events of September 11, 2001

and the subsequent tightening of immigration and visa protocols, policy makers have begun to explore other alternatives (Hilsenrath et al., 2003). One alternative includes osteopathic physicians (Hilsenrath et al., 2003).

The greater primary care and rural medicine presence by osteopaths is by design. All osteopathic education institutions emphasize primary care in training and most require rural clinical rotations. In contrast "as of 1997 over 5% of allopathic colleges of medicine did not even offer a clerkship or its equivalent in family medicine" (Tooke-Rawlins, 2000; Longest,1998). Although the Association of American Medical Colleges encourages production of rural physicians the results range widely, from over 40% of graduates from the University of North Dakota to 2.3% of Mt. Sinai's graduates entering rural practice (NRHA, 2003; Rosenblatt, Whitcomb, Cullen, Lishner, & Hart, 1992).

In studies of factors leading to the practice of rural medicine, the role of osteopathic medical training has not been fully explored. Many authors simply omit consideration of osteopathy as a factor in their studies--Rosenblatt and his colleagues chose not to mention osteopathic colleges in their 1992 review of medical schools that produce rural doctors. Neither did Rosenblatt and Hart (2000) when they described physician shortages and contributing factors in rural America. Recent articles regarding "critical factors" to increase rural primary care physician supply omitted the impact of an osteopathic degree on care of underserved populations and the role of medical school in rural graduate medical education (Rosenblatt & Hart, 2000; Rabinowitz et al., 2001; Rabinowitz & Paynter, 2000; Rabinowitz, Whitcomb, Cullen, Lishner, & Hart, 2000). Their overlooking the success of osteopathic institutions in training both rural physicians

and primary care physicians dampens some of their results. One example of osteopathic education's success in encouraging rural practice is that of the West Virginia School of Osteopathic Medicine (WVSOM). WVSOM is a state-supported medical school with the stated mission of placing doctors in rural Appalachia. By focusing on this mission WVSOM placed more doctors in rural Appalachia than any other U.S. medical school for the 12-year period studied (ending in 1990) (Roberts, Foster, Dennis, Davis, Wells, Bodemuller, & Bailey, 1993). In 2003 over 64% of osteopathic physicians were in primary care specialties, defined by the American Osteopathic Association as internal medicine, pediatrics, family practice, obstetrics and gynecology, and general practice (AOA, 2003). As the number of osteopathic physicians grows in the U.S. it will be important to recognize the ways in which they contribute to physician supply dynamics. Today over 35 million Americans see osteopathic physicians, and those numbers are growing rapidly (Glover & Rivers, 2000). In 2002, 2,534 physicians graduated from colleges of osteopathic medicine in the United States (Singer, 2003). It is projected that by 2020 there will be 80,000 DOs at practice in the U.S. (AOA, 2003).

Even within allopathic primary care residency training programs DOs are becoming more visible--allopathic post-doctoral training programs often fill their slots with qualified osteopaths, and are being cross-trained in allopathic residencies (Brotherton, 2002). In 1999 15.4% of osteopathic medical school graduates entered into ACGME accredited family practice residencies, compared to 13.4% of allopathic graduates entering those same residencies (Pugno, Schmittling, McPhereson, & Kahn, 2000). These numbers translate to 415 (11.4 %) of entrants into ACGME accredited

family practice residencies being graduates of osteopathic schools (Pugno et al., 2000). Osteopathic residencies train large numbers of family and general practice as well ((AOA, 2003).

Gender Influence on Medical Practice Choices

Another consideration is gender. Historically male physicians choose rural practice (Hart et al., 2002). Women physicians are less likely to locate in rural areas on their own (Hart et al., 2002; Brooks et al., 2002). West and his colleagues (1996) found that "female graduates (of family practice residency programs) had their initial practice locations in rural communities 21 percent of the time, while their male counterparts located in rural areas 38 percent of the time." Doescher and his colleagues (2000) found that although women made up 19% of the allopathic physicians in the 1996 AMA masterfile, only 13% of the rural physicians were women. He went on to report that Texas is included in the lowest quartile of states for measures of percentage of female rural physicians (Doescher, Ellsbury, & Hart, 2000).

Women also tend to enter generalist and family practice residencies in greater numbers relative to men (West, Norris, Gore, Baldwin, & Hart, 1996; Journal of the American Medical Association [JAMA], 2002). Female physicians also "cluster" around pediatrics, psychiatry, family practice, OB-Gyn, and internal medicine, comprising 60% of the total number of physicians in these fields (Simpson & Weiser, 1996). In 2001 49% of women resident physicians were training in primary care specialties (JAMA, 2002).

While there have always been fewer female physicians than male, this is changing. In 1997, 43% of first year medical students were women. By 2010 women

will represent 30% of the physician workforce (Hart et al., 2002). Women osteopaths are increasing in number as well as in their relative share of the physician workforce. In 1994 women represented 17% of all osteopathic physicians, levels similar to female MDs who accounted for 19% of allopathic physicians the same year (Simpson & Weiser, 1996). This trend is increasing as the number and percent of female graduates from osteopathic medical schools grows. In 1968, eight women graduated from five osteopathic medical schools, representing less than 2% of the graduates. By 1992, 533 women represented over 33% of the graduates from the 15 programs then extant, and in 2002 41% of graduates were women (Simpson & Weiser, 1996; Singer, 2003). Numeric parity between men and women in medicine is expected by 2030 (Simpson & Weiser, 1996).

These two trends—declining numbers of physicians entering rural practice and increasing numbers of women physicians—seem poised to accelerate the existing rural physician shortage by combining their effects.

Comparing Physicians by Degree

Meaningful comparisons between allopathic and osteopathic practitioners in the physician supply are sometimes difficult to make. The AMA Masterfile and its osteopathic Masterfile counterpart are most commonly used to estimate physician supply (Ricketts et al., 2000). The AMA's Masterfile includes information on osteopaths in allopathic residencies, but this information is incomplete. The AMA data does not include information for osteopaths who did not complete allopathic residencies, thereby leaving a small but significant portion of the physician supply uncounted. Similarly, the

American Osteopathic Association does not universally gather practice information for DOs who have completed allopathic residencies. This results in a patchwork of information that has limited utility (NRHA, 1998; Ricketts et al., 2000).

For comprehensive information about every practitioner it is necessary to turn to the licensing board for that state. For example, the Texas State Board of Medical Examiners maintains a list of every physician licensed to practice in the state. This comprehensive list distinguishes between allopathic and osteopathic physicians at the same time collecting all other information without distinction.

Texas' Demographic Profile

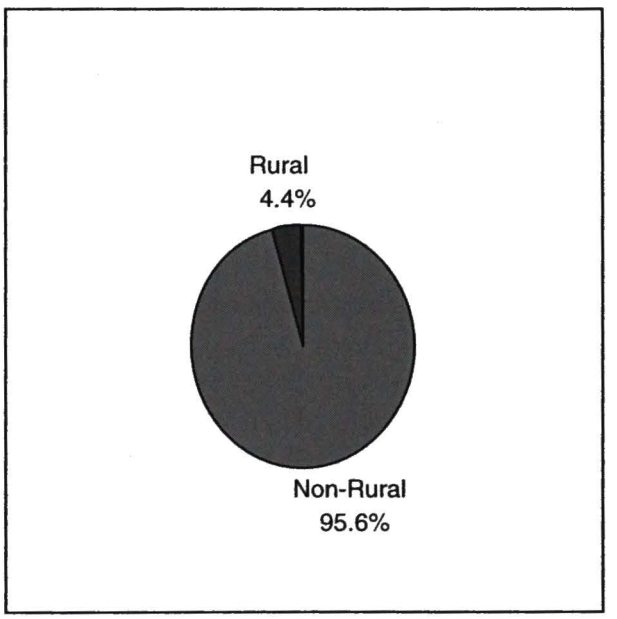
Texas' population at the 2000 Census count was reported as 20,851,820 (Murdoch, 2002). As the second largest state in landmass the population is characterized by large urban groupings scattered throughout with much smaller communities between. The five largest metropolitan statistical areas (MSA) are Austin-San Marcos, Dallas, Fort Worth-Arlington, Houston, and San Antonio. Together they account for almost 60% of the total population in Texas. Over 12.2 million Texans live in those five MSAs (Murdoch, 2002). Each of the five MSAs is home to more than 1 million Texans, while the other 22 MSAs together are home to more than 5 million. The total Texas population residing in a metropolitan statistical area as of the 2000 census was 17,691,880 (84.8%) (United States Census Bureau, 2000; Murdoch, 2002).

The rural population of Texas is also large. The OMB's definition of non-metropolitan counties as those not located inside a Metropolitan area, contain no places with a population of 50,000 or more or no Census Bureau defined "urbanized area", and a

total population of less than 100,000. Additionally outlying counties that have close economic and social ties with metropolitan areas and meet defined characteristics of metropolitan areas such as population density are not considered rural (RPRI, 2000). By this definition, Texas is home to 75 rural counties, with a combined population of 921,445 (4.4%) (figure 1) (Murdoch, 2002; Texas State Data Center, 2003). In 2001, 129 Texas counties were defined as Health Professional Shortage Areas for primary care (The Health of Texas: Texas State Strategic Plan, Part 1, 2002). Although this represents

Figure 1

Texas Population



only 4.4% of the total Texas population, taken as a whole this comprises the sixth largest grouping of Texans--more numerous than the citizens of 22 of the 27 MSAs in Texas (Murdoch, 2002).

The total land area of Texas (excluding surface water) is 261,797.12 square miles. The 4.4% of the population that is rural are spread across 36% (94,304 square miles) of that area, with an average population density of 9.77 people per square mile (U.S. Census Bureau, 2000). By contrast, the population density of Dallas County is over 2,522 people per square mile (U.S. Census Bureau, 2000).

This study of whether female DOs differ significantly from their counterparts in the rate at which they choose practice specialties and characteristics will allow public policy makers to address key issues in physician supply. By shedding light on some of the complex factors that drive physician specialty and location choices, policy makers can consider production of DOs, especially female DOs, to boost levels of primary care physicians and perhaps also slow the loss of rural primary care physicians.

CHAPTER II

DATA AND METHODS

Data

The Texas State Board of Medical Examiners (TSBME) archives information about every physician licensed to practice medicine in the state of Texas, which it offers for public purchase as a Complete Electronic Database (Texas State Board of Medical Examiners, Austin, Texas--$165.00). As of February, 2003, this record contains personal and practice demographic data for 52,856 doctors (TSBME, 2003). Of these 31,228 physicians meet study criteria and are included in the study data set. This study sets out to analyze the practice patterns of doctors in the public practice of medicine in Texas, therefore certain criteria are set for inclusion. These criteria are: the physician must be in the active practice of medicine; must currently practice in Texas; must not be a resident or intern physician, is not in practice in a setting that is not an HMO, hospital, solo, partnership or group practice; and must participate in direct patient care. Since they primarily serve special populations or have practice choices dictated by military or other obligations, physicians employed by the Public Health Service, the federal government, the military, and the Veteran's Administration were excluded from the study (Frenzen, 1991; West et al., 1996). Five doctors were excluded from the study because they failed to report their gender to the TSBME.

The TSMBE database consists of 35 fields of data, such as medical license number, birth date, ethnicity, practice type, and mailing address. The records of interest

to this study are the primary specialty, type of degree, practice type, practice setting, gender, and county in which the physician practices. This database distinguishes between osteopathic and allopathic physicians.

Information from the Texas State Data Center and Office of the State Demographer is used to determine if a Texas county is considered rural. No consistent criteria define a rural area in regard to health care, so we chose the narrowest definition (Rabinowitz, Diamond, Markham, & Hazelwood, 1999). For this a county is considered rural if its metropolitan status is listed as "non-metro non-adjacent," (a county which is not metropolitan and not adjacent to one that is). Seventy-five Texas counties meet this definition. Ten counties had no physician during the study period and were excluded.

The Office of Management and Budget (OMB) define counties located inside a metropolitan area as "metropolitan" counties. Others are considered "non-metropolitan" or "rural." These rural counties or metropolitan areas have populations of less than 50,000; no Census Bureau defined "urbanized area;" and a total population of less than 100,000. Additionally outlying counties which have close economic and social ties with metropolitan areas and meet defined characteristics of metropolitan areas such as population density are not considered rural (Rural Policy Research Institute [RPRI], 2000).

Methods

Data from the TSBME and the Office of the State Demographer were compiled to compare the rate at which physicians of different types are found in medical practices across Texas as of 2003. Of special interest are the prevalence of female DOs in primary

care specialties and the prevalence of female DO primary care physicians with practice locations in rural areas. Physicians included in the study were coded to obscure name, license number, and birth date.

Data was examined with three tools: SPSS, version 11.0 for Windows (SPSS Inc., Headquarters, 233 South Wacker Drive, Eleventh Floor, Chicago, IL 60606, 2002); Microsoft Excel 2002, (Microsoft Corporation, One Microsoft Way, Redmond, Washington 98052), and using hand calculations as described by Rosner in Fundamentals of Biostatistics, 5th Edition, 2000. (Duxbury, 511 Forest Lodge Road, Pacific Grove, CA 93950 USA).

For both primary care and rural primary care a cross-sectional study was conducted using 2X2 contingency tables (see table 1) (Rosner, 2000). This allows the prevalence of primary care and rural primary care practice at the time of the sample to be compared among groups of physicians (Rosner, 2000). Female DOs were compared separately to the following categories of Texas physician: all others, male DOs, female MDs, and male MDs. The odds ratio (OR) for being a currently practicing primary care physician in Texas was calculated for each category of physician, with significance determined using the Yates-Corrected chi-square test (Rosner, 2000). As the odds ratio is considered a good estimate of the relative risk for occasions where the outcome under study is rare it is the appropriate measure for this study (Hennekens & Buring, 1987). Odds ratio is given by the formula OR=ad/bc (table 1) (Rosner, 2000). In addition, each of the three remaining categories of physician—male DOs and male and female MDs—

were compared against the balance of physicians to determine the OR specific to that degree type and gender for primary care and rural primary care practice in Texas.

Table 1

2X2 Table for Female DO Prevalence in Texas Primary Care, Example

	Primary Care	Non-Primary Care
Female DO	a	b
Other Physician	c	d

95% confidence intervals were obtained for all calculated ORs using the Woolf Procedure for interval estimation (Rosner, 2000). Observed and expected values were calculated for the rate of primary care and rural primary care practice among categories, and the Yates-Corrected chi-square test for a 2X2 contingency table was calculated with the equation $X^2 = (|O_{11} - E_{11}| - 0.5)^2 / E_{11} + (|O_{12} - E_{12}| - 0.5)^2 / E_{12} + (|O_{21} - E_{21}| - 0.5)^2 / E_{21} + (|O_{22} - E_{22}| - 0.5)^2 / E_{22}$ (Rosner, 366). The result of the chi-square test was compared to the chi-square distribution to determine statistical significance (Rosner, 758), and exact p-values for each comparison category's chi-square result were obtained by using Microsoft Excel's CHITEST function. Expected values were obtained by multiplying the various groupings of physician type by the population probability for selection of primary care practice in the sample as outlined by Rosner, and checked with Microsoft's Excel 2002. Descriptive data were obtained with SPSS for Windows,

version 11.0. Calculations, chi-square results, and tables of observed and expected values for both primary care and rural primary care are located in appendices B and C.

It is desirable to control for the effect of greater saturation of osteopaths in primary care specialties when considering the choice of rural practice locations. In order to do so some comparisons for choice of rural practice locations were made both among identified primary care physicians as well as the entire physician population. It is important to recognize that many factors contribute to the selection of rural practice locations. The intent of this work is to focus on the broad contributions of physician groups rather than the characteristics of individuals. For this reason attempts were not made to control for the many specific variables that affect practice choices.

CHAPTER III

RESULTS

Descriptive Statistics

In February 2003 there were 52,387 physicians licensed to practice medicine in Texas (TSBME, 2003). Of these, 12,792 physicians list their mailing address outside Texas and presumably do not practice medicine in Texas and 2,407 were currently licensed but not engaged in the active practice of medicine. A further 5,960 physicians do

Table 2

Texas Physician Demographics

Degree Type	Gender	Specialty Type				Total
		Primary		Non-Primary		
		Rural	Non-Rural	Rural	Non-Rural	
DO	Female	10	253	3	108	374
	Male	54	806	23	635	1,518
MD	Female	68	2,959	52	3,176	6,255
	Male	385	7,349	399	14,948	23,081
		517	11,367	477	18,867	
Total private practice physicians*						31,228

* Physicians who meet one or more of the following criteria are excluded from exhibit: not active in medical practice; practice located outside of Texas; does not practice direct patient care; is a resident or intern; or practice setting is outside of HMO, hospital based, solo, partnership or group practice.

not meet criteria for inclusion in the study as outlined in the methods section. The doctors of Texas analyzed in this study consist of the remaining 31,228 physicians (Table 2) (TSBME, 2003). This population of 31,228 physicians is referred to as "private practice physicians" through the following sections.

According to the Texas State Board of Medical Examiners, in February of 2003, 93.9% (29,336) of Texas private practice physicians were MDs and 6.1% (1,892) were DOs (TSBME, 2003). In the same month the TSBME reported that 21.2% (6,629) of Texas' private practice physicians were women, while 78.8% (24,599) were men (Tables 1 and 2).

Table 3

Physicians by Degree and Gender

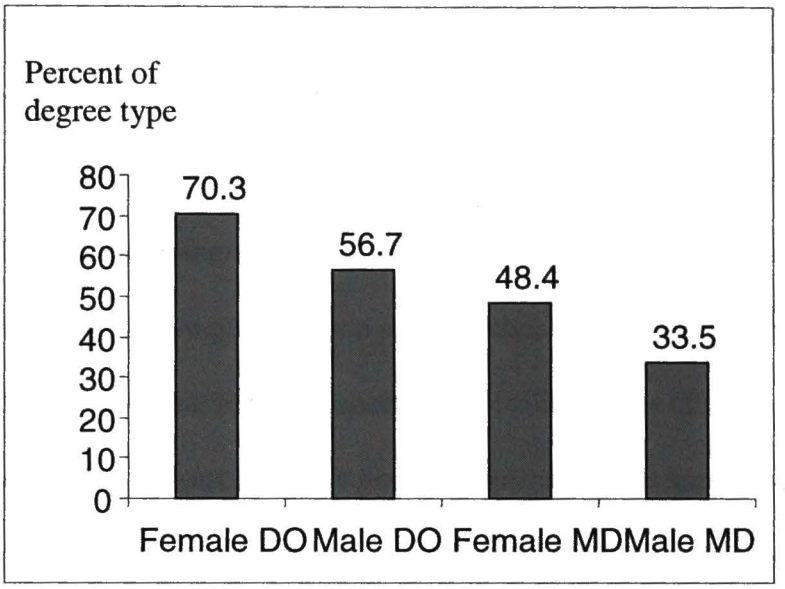
	MD		DO		Total	
	number	percent	number	percent	number	percent
Men	23,081	(73.9)	1,518	(4.9)	24,599	(78.8)
Women	6,255	(20.0)	374	(1.2)	6,629	(21.2)
total	29,336	(93.9)	1,892	(6.1)	31,228	(100.0)
• N=31,228						

(TSBME, 2003)

Of the 1,892 DOs of interest in Texas, 374 (19.8%) are women and 1518 (80.2%) are men. Of the 29,336 MDs of interest in Texas, 6,255 (21.3%) are women and 23,081 (78.7%) are men (Table 1) (TSBME, 2003).

Figure 2

Physicians Within Type in Primary Care



Most Texas physicians are located in a metropolitan environment. Of the 39,595 licensed physicians (all categories) with a Texas address 37,434 (94.5%) are located within one of the 27 Texas metropolitan statistical areas (TSBME, 2003; Murdoch, 2002). Only 3.2% (994) of all Texas physicians are located in a non-metro, non-adjacent setting (TSBME, 2003). In February of 2003, 38.1% (11,884) of Texas private

Table 4

Primary Care by Degree and Gender

	DO		MD		Total	
	number	percent	number	percent	number	percent
Men	860	(7.2%)	7,734	(65.1%)	8,594	(72.3%)
Women	263	(2.2%)	3,027	(25.5%)	3,290	(27.7%)
total	1,123	(9.5%)	10,761	(90.6%)	11,884	(100.0%)
* N=11,884						

practice physicians were engaged in primary care medicine, defined as the fields of internal medicine, general practice, family practice, and pediatrics (Table 4) (TSBME, 2003).

Research Population

Of the 11,884 Texas private practice physicians who practice primary care 1,123 (9.4%) are DOs. The remaining 10,761 (90.5%) private practice physicians are MDs. Female osteopathic physicians practice in a primary care specialty more than twice as often as male MDs—70.3% to 33.5%, respectively (Table 4). As of February 2003, 70.3% of female DOs of interest in Texas practice a primary care specialty, while 57% of male Texas DOs practice in a primary care field (Table 5). At the same time, 48.4% of female MDs of interest in Texas practice in a primary care specialty as do 33.5% of male MDs of interest (Table 5).

Table 5

Percent of Physicians in Primary Care by Degree and Gender

	DO		MD		Total
	number	% within type	number	% within type	number
Men	860	(56.7%)	7,734	(33.5%)	8,594
Women	263	(70.3%)	3,027	(48.4%)	3,290
Total (% within type)	1,123	(59.4%)	10,761	(36.7%)	11,884

When primary care practiced in a rural setting (non-metro, non adjacent) is considered, the number of private practice physicians decreases dramatically (Table 1). Only 517

primary care physicians serve the rural population in Texas—one per each 1,782 persons or 56 per 100,000. The ratio of residents to primary care physician is almost the same as the non-rural population. The 19,930,375 non-rural Texans have about one primary care physician per each 1,753 residents, or 57 per 100,000

While home to 4.4% of the Texas population, 4.6% of primary care physicians practice in rural areas. However, when viewed as primary care physicians per square mile the disparity becomes more apparent. There is one rural primary care physician per every 182.4 square miles of rural county, while there is one non-rural primary care physician per every 22 square miles of non-rural county (TSBME, 2002, Texas State Demographer; 2003).

Table 6

MDs and Dos in Rural Primary Care Within Degree and Gender

	DO		MD		Total (% all doctors**)
	number	% within type	number	% within type	
Men	54	(3.6%)	385	(1.7%)	439 (1.4%)
Women	10	(2.7%)	68	(1.1%)	78 (0.25%)
Total (% within type)	64	(3.4%)	453	(1.5%)	517 (1.7%)
* N=517 ** N=31,228					

Most rural primary care physicians in Texas are male MDs, comprising 75% of the whole. Female MDs make up 13%, with male DOs and female DOs making up 10%

and 2%, respectively. Both male and female osteopathic physicians practice primary care in rural Texas at a higher rate than do MDs of either gender—3.6% of male DOs, 2.7% of female DOs, 1.7% of male MDs, and 1.1% of female MDs in the sample practice rural primary care in Texas (Tables 5 and 6).

Table 7

Texas Physician Demographics as Percent** of Physician Population, February 2003

Degree Type	Gender	Specialty Type				Total Physician Population
		Primary		Non-Primary		
		Rural	Non-Rural	Rural	Non-Rural	
DO	Female	2.7%	67.7%	0.8%	29.9%	374
	Male	3.6%	53.1%	1.5%	41.8%	1,518
MD	Female	1.1%	47.3%	0.8%	50.8%	6,255
	Male	1.7%	31.8%	1.7%	64.8%	23,081
Total private practice physicians*		1.7%	36.4%	1.5%	60.4%	31,228

* Physicians who meet one or more of the following criteria are excluded from exhibit: not active in medical practice; practice located outside of Texas; does not practice direct patient care; is an intern or resident; or practice setting is outside of HMO, hospital based, solo, partnership or group practice.
**Totals may exceed 100% due to rounding

Odds Ratios for Primary Care Specialty in Texas, 2003

The odds ratio (OR) for a female osteopathic physician being in primary care practice in Texas in February 2003 is 3.92 with a 95% confidence interval (c.i.) from 3.16

to 4.90. Chi-square results were highly significant as well with a p-value of <0.001. This OR is over twice that of male osteopathic and female allopathic physicians, and eight

Table 8

Overall Odds Ratio for Primary Care Practice

	Female	Male
DO	3.92 95% c.i.= 3.16 to 4.90	2.22 95% c.i.= 2.00 to 2.46
MD	1.71 95% c.i.= 1.62 to 1.81	0.49 95% c.i. = 0.47 to 0.52
N=31,228		

times that of male MDs (Tables 6 and 8). When female osteopathic physicians are compared individually to specific physician categories, the odds ratios show that female DOs are much more likely to practice primary care than any other category of physician (Table 9).

Table 9

Overall Odds Ratio of Primary Care Practice—Specific Comparisons

	Male DO	Female MD	Male MD
Female DO vs:	1.81*** 95% c.i.=1.42 to 2.31	2.53** 95% c.i.=2.02 to 3.18	4.7* 95% c.i.=3.69 to 5.99
*N= 23,455 **N= 6,629 ***N=1892			

Overall Odds Ratios for Rural Primary Care Specialty

Osteopathic physicians are over represented in rural primary care when compared as a percent of physician type. Male DOs are most numerous within their type with 3.6%

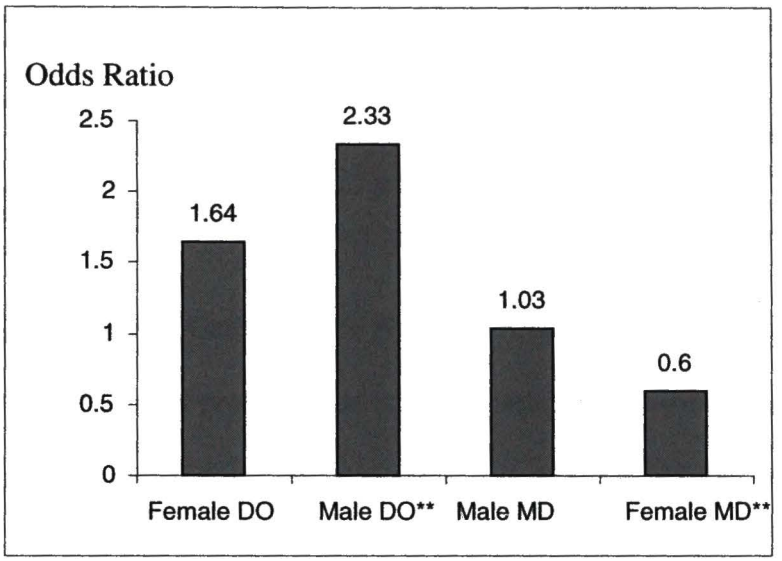
in rural primary care, followed by 2.7% of female DOs, then male and female MDs with 1.7% and 1.1% respectively (Table 7).

Physician subtypes were compared to the private practice physician population to determine the odds ratio of rural primary care practice. In this comparison only 2 statistically significant results were obtained, those for male DOs and female MDs. When compared to all other private practice physicians for rural primary care practice, male DOs have an OR of 2.33 with a 95% c.i. from1.75 to 3.10. Chi-square comparisons for male DOs are significant with a chi-square=34.22, p-value<0.0000. Female MDs show a statistically significant disinclination to practice rural primary care when compared to all other private practice physicians. The OR for this group to practice rural primary care is 0.60 with a 95% c.i. from 0.46 to 0.78. Chi-square comparisons for female MDs are also significant with a chi-square=15.42, p-value=0.0007.

The OR of a female osteopathic physician being in rural primary care practice in Texas in February 2003 is 1.64 with a 95% c.i. from 0.87 to 3.09 (Figure 3). Chi-square comparisons yield a chi-square of 2.04 with a p-value of 0.09921. Male MDs have an OR of 1.03, with a 95% c.i. from 0.84 to 1.26, and a chi-square of 0.064 with a p-value=0.762.

Figure 3

OR for Rural Primary Care Practice*



** outside 95% confidence interval
* N=517

When female osteopathic physicians are compared individually to specific physician categories, the odds ratios for rural primary care change somewhat, yielding statistically significant differences in the prevalence of female DOs and female MDs (Table 11). In a direct comparison female DOs are seen to be 2.5 times as likely as female MDs to practice rural primary care, with a 95% c.i. of 1.27 to 4.88. Chi-square comparison yields a value of 9.09 with a p-value=0.0011. Other differences exist as well. When compared directly to male MDs, female DOs are 1.6 times as likely to practice rural primary care. This value is not significant at the 0.05 alpha level, however, with a 95% confidence interval of 0.86 to 3.06, and a chi-square comparison calculated at 2.39 with a p-value=0.10 (Table 11).

Table 10

Odds Ratio of Rural Primary Care Practice--Specific Comparisons

	Male DO	Female MD	Male MD
OR: Female DO vs.	0.745 95% c.i.=0.38 to 1.48	2.49* 95% c.i.=1.27 to 4.88	1.62 95% c.i.=0.86 to 3.06
* Outside 95% confidence interval;			

Prevalence of Rural Primary Care Practice Among Primary Care Physicians

When looking at rural practitioners it is desirable to describe the proportion of primary care physicians who choose rural practice locations (Table 11). When compared

Table 11

Primary Care MDs and DOs in Rural Primary Care

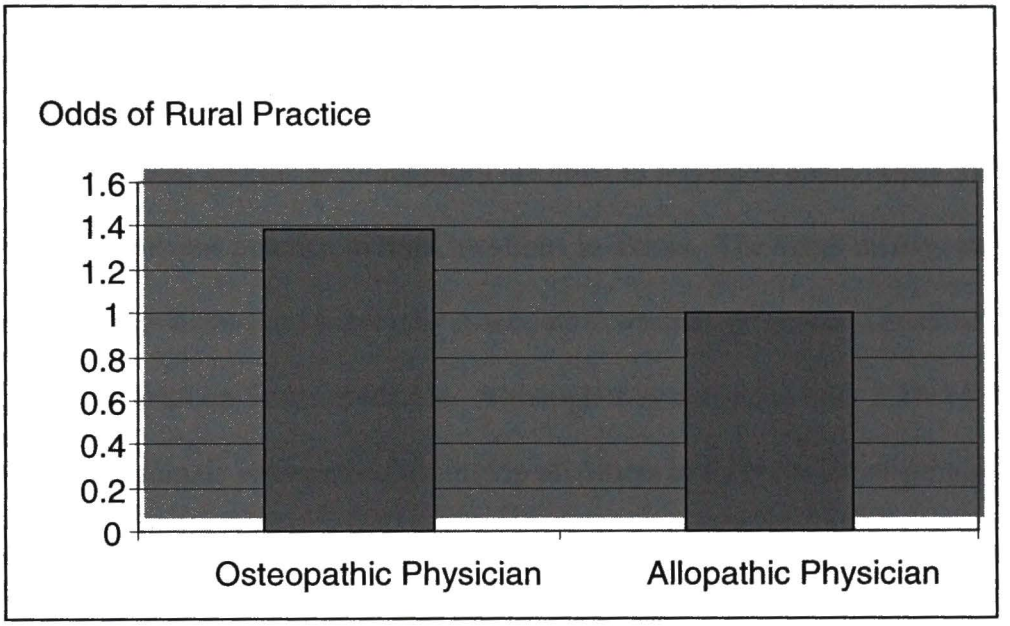
	DO		MD		Total (% all primary care**)
	number	% within gender and type	number	% within gender and type	
Men	54	(6.3%)	385	(5.0%)	439 (3.7%)
Women	10	(3.8%)	68	(2.2%)	78 (0.7%)
Total (% of degree type in primary care)	64	(5.7%)	453	(4.2%)	517 (4.4%)
** N=11,885					

directly, osteopathy shows a significant effect on the choice of rural primary care practice, with osteopathic physicians 1.4 times as likely to select rural practice sites as

allopathic physicians. This finding may be a reflection of the effect of osteopathic training elements rather than gender and practice type, and is significant with a 95% confidence interval for the odds ratio of 1.05 to 1.80 (Figure 4).

Figure 4

OR for Rural Primary Care with Confounding by Gender and Primary Care Controlled



95% confidence interval 1.05 to 1.80

CHAPTER IV

DISCUSSION

There are significant differences in the prevalence of female osteopathic physicians in both primary and rural primary care practice in Texas. There are 11,884 private practice primary care physicians of all degree types in Texas. Most (90.6%) are allopathic physicians, and the great majority are sited in non-rural areas. Only 517 primary care physicians practice in rural locations in Texas. The small relative number of osteopathic physicians, and especially osteopathic women, promotes a tendency to overlook their impact on Texas medicine. Although they comprise only 2.2% of the study population female osteopaths far outstrip all others in their choice of primary over non-primary care practice. Female osteopaths are also relatively more likely to become rural primary care physicians than either female allopaths.

Over 70% of female osteopaths in Texas have chosen to practice primary care. This proportion is based on the strictest definition of primary care, excluding specialties included by the AOA and others such as general surgery, emergency medicine, and obstetrics/gynecology. This difference in specialty selection makes itself felt in the rural physician supply as well, where the choice of primary care specialty is a leading indicator for rural medical practice (Hart et al., 2002, NRHA, 2003, Rabinowitz et al., 2001). Despite their tiny numbers female osteopaths are more well represented compared to female allopaths by a ratio of 2 ½ to 1 in rural primary care. This is particularly notable

as women edge toward numerical parity with men in the practice of medicine (Simpson & Weiser, 1996). Percentages of women currently enrolled in medical schools are roughly similar for both allopathic and osteopathic colleges of medicine. Given their tendencies toward primary care practice it is reasonable to expect all women's practice patterns to have a growing influence on the shape of rural medicine in the coming years (COGME, 2000). With their large relative presence in rural primary care, osteopathic women may play an especially significant part in this.

Also notable is the under representation of allopaths in both primary and rural primary care. Only 33% of male allopaths practice primary care, as do fewer than half of female allopaths. That male allopaths practicing rural primary care are more numerous than any other physician type conceals the fact that those who do represent only 1.7% of all male allopaths. Similarly female allopaths in rural primary care represent only 1.1% of their number. In contrast, both male and female osteopaths are represented in rural primary care at much higher relative numbers—3.6% and 2.7%, respectively (Table 7).

The difference in the rate at which female osteopaths enter primary care is made more striking when compared relative to other physicians. For these comparisons the odds ratio (OR), or the relative likelihood of entering primary or rural primary care, was calculated. Once again the small number of female osteopaths masked their relative importance to the Texas physician supply.

The OR for a female osteopath to practice primary care in Texas is more than twice that of male osteopathic and female allopathic physicians, and eight times that of

male allopaths. Compared only to male allopaths, female osteopaths in Texas are 4.7 times as likely to practice primary care. Furthermore, there are statistically significant differences in the rate at which female osteopaths practice rural primary care when compared with female allopaths. As of February 2003, female osteopaths are 2.5 times more likely to practice rural primary care than their female allopathic counterparts. Other comparisons among physicians engaged in rural primary practice identified differences as well (although not statistically significant). Most notable is that female osteopaths are 1.6 times more likely to practice rural primary care than other physicians taken as a group. Although that OR falls short of the 95% confidence interval, it does suggest a trend.

Male osteopathic physicians have the highest OR for rural primary care practice among all physician types. Male osteopaths are 2.3 times as likely as the other physicians in the sample to practice rural primary care when compared to all others. This difference deserves future study.

The literature suggests that the higher relative rate of rural practice seen with osteopathic physicians is a product of their tendencies to primary care. Gender is also a leading indicator for the practice of rural primary care (Hart et al., 2002; Brooks et al., 2002). Both factors can be seen at work in this study. However when compared directly to allopathic physicians osteopaths do show a statistically significant tendency to practice rural primary care with an odds ratio of 1.4 (95% c.i. 1.05 to 1.8).

Limitations

There are several limitations to this study. They include the fact that this is a prevalence study and does not necessarily reflect trends. The study does not consider the tendency for physicians to stay in the state in which they were educated and trained. This would suggest that a state with a college of osteopathic medicine such as Texas will have a greater saturation of osteopathic physicians. In addition, within the literature the definitions of rural practice, practicing physician, and primary care are inconsistent, and make some comparisons difficult.

Economists argue that the economic location theory dictates dispersal of physicians into areas which can support their practice (Frenzen, 1991). Thus, the overall growth of physician supply should result in a "trickle down" effect to smaller communities (Frenzen, 1991). Although there has been some increase in the number of rural physicians, most agree that overall need remains unmet although this is by no means universally agreed upon (Frenzen, 1991, COGME, 2000). In this review it is noted that in gross terms non-rural Texans have about one primary care physician per each 1,753 residents, or 57 per 100,000. and that levels for the rural population are very similar at 56 per 1000. In 2002, Hart and his colleagues (2002) reported patient care generalist physician levels in 1997 from 91 per 100,000 in large metro counties to 38 per 100,000 in small rural areas for a national average of about 55 per. 100,000. For the interest of this study, however, the assumption is made that there is indeed a compelling need to produce more primary care and rural primary care physicians.

more than their allopathic counterparts. In Texas, the focus of this study, the observations are dramatic. With over 50,000 physicians licensed to practice in the state of Texas, it is easy to diminish the importance of the tiny minority of osteopathic women. These findings reveal that this minority of physicians, tiny as it is, exerts an effect on Texas medicine that is magnified by their practice choices.

Evidence from this study supports the contention that osteopathic women are a growing force in Texas medicine. Although their numbers are small osteopathic women are much more likely than any other physician type to practice primary care medicine. When the focus is narrowed to rural primary care practice, osteopathic women continue to distinguish themselves. Osteopathic women outpace allopathic women in the choice of rural primary care practice by more than two-and-a-half times, a ratio that holds special significance when viewed in light of women's growing share of the nation's physician supply.

These results suggest that policy intended to produce primary care or rural primary care physicians must consider the effects of gender and medical education on physicians' practice and location choices. Either issue is a significant indicator for practice choices—osteopathic education influences primary care and rural primary care practices, while female gender influences are mixed, with tendencies toward primary care and away from rural practice. Taken together, the effect of osteopathic education seems to overcome much of the tendency of women away from rural practice. Assuming that the results of this study are valid and can be applied to the greater physician population an illustration of the compound effects of gender and degree type can be as follows: the

production of 1000 physicians of a certain gender or degree type will yield very different results. If policy makers were given a choice of producing 1000 female osteopaths or the same number of female allopaths, these results suggest that 703 of these female osteopaths will practice primary care, of whom 27 will locate in a rural location. Of 1000 female allopaths produced, the yield is much smaller in terms of primary and rural primary care; 484 primary and only 11 rural primary care physicians. In the same comparison between male osteopaths and male allopaths, 1000 male osteopaths yield 567 primary care physicians, of whom 36 might be in rural areas. The 1000 male allopaths yield 335 primary care physicians, with 17 as rural practitioners.

These study results, as dramatized by this simple comparison, make clear that encouraging production of osteopathic physicians of either gender will yield the greatest return in terms of primary care and rural primary care physicians. For the production of rural primary care physicians female osteopaths have an edge, with 2 ½ times as many produced as by an equal number of female allopaths.

Numerous governmental and private initiatives exist to improve rural health and health care delivery. Many of these focus on production of family practitioners and promotion of "rural track" training and residency programs (COGME, 2000). One of the most prominent efforts is through the U.S. Department of Health and Human Services' Office of Rural Health Policy, through which there are dozens of programs and studies being conducted to study the rural health landscape (Office of Rural Health Policy, 2003). Although many physician workforce studies are included, none of them consider the circumstances described in this study (Office of Rural Health Policy, 2003). Policy

makers must not ignore the influence of the osteopathic physicians, especially female osteopaths, on the nation's primary and rural primary care landscape any longer. The promotion and support colleges of osteopathic medicine and the encouragement of medical school candidates to consider osteopathic training will both bring great yields to the primary care and rural primary care fields.

APPENDIX A

PHYSICIAN AND POPULATION DEMOGRAPHICS

Non-Metro, Non Adjacent Texas Counties and their Populations at 2000 Census

County	Population	County	Population
Angelina	80,130	Kinney	3,379
Bailey	6,594	Knox	4,253
Borden	729	Lamar	48,499
Brewster	8,866	Lipscomb	3,957
Briscoe	1,790	Llano	17,044
Brown	37,674	Loving	67
Childress	7,688	McCulloch	8,205
Cochran	3,730	Mason	3,738
Collingsworth	3,206	Mills	5,151
Colorado	20,390	Mitchell	9,698
Comanche	14,026	Montague	19,117
Cottle	1,904	Motley	1,426
Crockett	4,099	Nacogdoches	59,203
Culberson	2,975	Ochiltree	9,006
Dallam	6,222	Parmer	10,016
Dawson	14,985	Pecos	16,809
Dickens	2,762	Presidio	7,304
Donley	3,828	Real	3,047
Eastland	18,297	Reeves	13,137
Edwards	2,162	Roberts	887
Foard	1,622	Sabine	10,469
Franklin	9,458	San Augustine	8,946
Frio	16,252	San Saba	6,186
Gains	14,467	Scurry	16,361
Gillespie	20,814	Shelby	25,224
Gray	22,744	Sherman	3,186
Hall	3,782	Stephens	9,674
Hansford	5,369	Stonewall	1,693
Hardeman	4,724	Sutton	4,077
Haskell	6,093	Terrell	1,081
Hemphill	3,351	Titus	28,118
Houston	23,185	Trinity	13,779
Howard	3,627	Uvalde	25,926
Jeff Davis	2,207	Val Verde	44,856
Kent	829	Wheeler	5,284
Kerr	43,653	Yoakum	7,322
Kimble	4,468	Zavala	11,600
King	356		

(U.S. Census Bureau 2000; Texas State Data Center 2003)

Texas Physicians, by Metropolitan Statistical Area (all specialties/all status) 2/2003

MSA	Number of Physicians
Abilene	265
Amarillo	493
Austin-San Marcos	2,461
Beaumont-Port Arthur	596
Brazoria	168
Brownsville-Harlingen-San Benito	442
Bryan-College Station	330
Corpus Christi	772
Dallas	7,125
El Paso	880
Ft. Worth-Arlington	2,766
Galveston-Texas City	678
Houston	8,768
Killeen-Temple	697
Laredo	188
Longview-Marshall	328
Lubbock	709
McAllen-Edinburg-Mission	647
Odessa-Midland	366
San Angelo	211
San Antonio	3,632
Sherman-Denison	216
Texarkana	237
Tyler	598
Victoria	196
Waco	393
Wichita Falls	272
Total licensed physicians, all MSAs	37,434

(TSBME 2003, Murdock, 2002)

Texas Physician Demographics by Gender and County, (boldface indicates nmna county)

County	Male	Female	Total	County	Male	Female	Total
Anderson	68	15	83	Jones	5	1	6
Andrews	8	3	11	Karnes	5	0	5
Angelina	127	22	149	Kaufman	62	18	80
Aransas	15	2	17	Kendall	24	8	32
Archer	1	0	1	**Kerr**	**106**	**26**	**132**
Atacosa	19	7	26	**Kimble**	**3**	**0**	**3**
Austin	9	1	10	**Kinney**	**1**	**0**	**1**
Bailey	**6**	**0**	**6**	Kleberg	19	2	21
Bandera	4	0	4	**Knox**	**2**	**1**	**3**
Bastrop	16	5	21	La Salle	3	0	3
Baylor	3	0	3	Lamb	5	1	6
Bee	15	4	19	Lampasas	7	1	8
Bell	551	125	676	Lavaca	16	5	21
Bexar	2637	804	3441	Lee	1	2	3
Blanco	2	1	3	Leon	4	1	5
Bosque	8	1	9	Liberty	37	11	48
Bowie	203	34	237	Limestone	18	3	21
Brazoria	127	41	168	Live Oak	3	1	4
Brazos	270	59	330	**Llano**	**11**	**3**	**14**
Brewster	**8**	**2**	**10**	Lubbock	573	136	709
Brooks	3	0	3	Lynn	2	0	2
Brown	**56**	**9**	**65**	Madison	7	0	7
Burleson	3	0	3	Marion	5	0	5
Burnet	29	8	37	Martin	3	0	3
Caldwell	9	3	12	**Mason**	**1**	**0**	**1**
Calhoun	18	4	22	Matagorda	30	9	39
Callahan	2	1	3	Maverick	33	5	38
Cameron	358	84	442	**McCulloch**	**6**	**0**	**6**
Camp	8	1	9	McClennan	336	57	393
Cass	14	1	15	Medina	12	2	14
Castro	5	2	7	Menard	1	0	1
Chambers	3	0	3	Midland	144	34	178
Cherokee	64	10	74	Milam	10	0	10
Childress	**7**	**0**	**7**	**Mills**	**1**	**1**	**2**
Clay	3	1	4	**Mitchell**	**5**	**0**	**5**
Cochran	**0**	**1**	**1**	**Montague**	**13**	**0**	**13**
Coke	2	1	3	Montgomery	270	79	349

Coleman	4	0	4	Moore	12	4	16
Collin	540	209	749	Morris	3	0	3
Collingsworth	**4**	**0**	**4**	**Motley**	**2**	**0**	**2**
Colorado	**23**	**4**	**27**	**Nacogdoches**	**107**	**17**	**124**
Comal	95	25	120	Navarro	41	4	45
Comanche	**13**	**1**	**14**	Newton	6	1	7
Concho	2	0	2	Nolan	15	1	16
Cooke	22	1	23	Nueces	616	124	740
Coryell	15	6	21	**Ochiltree**	**6**	**0**	**6**
Crane	3	1	4	Orange	39	7	46
Crockett	**1**	**0**	**1**	Palo Pinto	23	3	26
Crosby	3	0	3	Panola	12	1	13
Culberson	**3**	**0**	**3**	Parker	46	12	58
Dallam	**7**	**1**	**8**	**Parmer**	**3**	**0**	**3**
Dallas	4170	1344	5515	**Pecos**	**9**	**2**	**11**
Dawson	**8**	**2**	**10**	Polk	21	4	25
Deaf Smith	7	4	11	Potter	352	69	421
Delta	1	0	1	**Presidio**	**1**	**0**	**1**
Denton	384	137	521	Rains	1	0	1
DeWitt	11	1	12	Randall	58	14	72
Dickens	**1**	**0**	**1**	Reagan	2	0	2
Dimmit	9	2	11	**Real**	**2**	**1**	**3**
Donley	**1**	**0**	**1**	Red River	9	0	9
Duval	2	1	3	**Reeves**	**10**	**0**	**10**
Eastland	**10**	**2**	**12**	Refugio	2	0	2
Ector	156	32	188	Robertson	4	0	4
Edwards	**1**	**0**	**1**	Rockwall	41	10	51
El Paso	729	151	880	Runnels	3	3	6
Ellis	61	15	76	Rusk	22	6	28
Erath	30	9	39	**Sabine**	**4**	**0**	**4**
Falls	8	3	11	San Augustine	3	0	3
Fannin	19	7	26	San Jacinto	2	1	3
Fayette	18	4	22	San Patricio	25	7	32
Fisher	1	1	2	**San Saba**	**3**	**0**	**3**
Floyd	4	0	4	Schleicher	0	1	1
Fort Bend	221	120	341	**Scurry**	**10**	**3**	**13**
Franklin	**8**	**1**	**9**	Shackelford	1	1	2
Freestone	8	0	8	**Shelby**	**7**	**5**	**12**
Frio	**10**	**1**	**11**	**Sherman**	**1**	**0**	**1**
Gaines	**7**	**0**	**7**	Smith	507	91	598
Galveston	465	213	678	Somervell	8	1	9

Garza	2	0	2	Starr	15	2	17
Gillespie	**49**	**10**	**59**	**Stephens**	**5**	**2**	**7**
Goliad	0	2	2	**Sutton**	**2**	**0**	**2**
Gonzales	11	1	12	Swisher	2	1	3
Gray	**19**	**4**	**23**	Tarrant	2061	507	2568
Grayson	186	30	216	Taylor	232	33	265
Gregg	220	44	264	Terry	8	1	9
Grimes	11	2	13	Throckmorton	1	0	1
Guadalupe	43	16	59	**Titus**	**43**	**6**	**49**
Hale	36	7	43	Tom Green	188	23	211
Hall	**2**	**0**	**2**	Travis	1516	519	2035
Hamilton	8	0	8	**Trinity**	**6**	**0**	**6**
Hansford	**3**	**0**	**3**	Tyler	9	3	12
Hardeman	**5**	**1**	**6**	Upshur	12	0	12
Hardin	16	1	17	Upton	2	0	2
Harris	5824	2196	8021	**Uvalde**	**19**	**3**	**22**
Harrison	44	8	52	**Val Verde**	**29**	**7**	**36**
Haskell	**2**	**0**	**2**	Van Zandt	15	0	15
Hays	96	36	132	Victoria	172	24	196
Hemphill	**3**	**1**	**4**	Walker	54	8	62
Henderson	56	4	60	Waller	6	0	6
Hidalgo	531	116	647	Ward	6	1	7
Hill	20	7	27	Washington	28	3	31
Hockley	13	3	16	Webb	169	19	188
Hood	34	6	40	Wharton	44	16	60
Hopkins	24	6	30	**Wheeler**	**7**	**0**	**7**
Houston	**16**	**1**	**17**	Wichita	224	47	271
Howard	**48**	**7**	**55**	Wilbarger	18	5	23
Hunt	62	11	73	Willacy	10	0	10
Hutchinson	16	6	22	Williamson	181	80	261
Irion	0	1	1	Wilson	9	3	12
Jack	5	0	5	Winkler	4	1	5
Jackson	7	2	9	Wise	24	5	29
Jasper	31	4	35	Wood	24	5	29
Jeff Davis	**1**	**0**	**1**	**Yoakum**	**5**	**0**	**5**
Jefferson	464	69	533	Young	14	0	14
Jim Hogg	2	0	2	Zapata	1	2	3
Jim Wells	33	5	38	Zavala	5	0	5
Johnson	84	16	100				

(TSBME, January 2003)

Metropolitan Statistical Areas and their Populations, 2000

MSA	Population
Abilene	126,555
Amarillo	217,858
Austin-San Marcos	1,249,763
Beaumont-Port Arthur	385,090
Brazoria	241,767
Brownsville-Harlingen-San Benito	335,227
Bryan-College Station	152,415
Corpus Christi	380,783
Dallas	3,519,176
El Paso	679,622
Ft. Worth-Arlington	1,702,625
Galveston-Texas City	250,158
Houston	4,177,646
Killeen-Temple	312,952
Laredo	193,117
Longview-Marshall	208,780
Lubbock	242,628
McAllen-Edinburg-Mission	599,463
Odessa-Midland	237,132
San Angelo	104,010
San Antonio	1,592,383
Sherman-Denison	110,595
Texarkana	89,306
Tyler	174,706
Victoria	84,088
Waco	213,517
Wichita Falls	140,518
Total MSA population	17,691,880

(U.S. Census Bureau 2003; Murdock, 2002)

APPENDIX B

CALCULATIONS AND TABLES OF OBSERVED AND EXPECTED VALUES:

PRIMARY CARE

Female Osteopathic Physicians vs. All Other Types:

Primary Care Physicians in Texas, February 2003--Observed Values (Expected Values)

	Primary Care		Non-Primary Care	
	Observed	(Expected)	Observed	(Expected)
Female DO	263	(142)	111	(232)
Other Physician	11,621	(11,743)	19,233	(19,111)
OR=3.92; 95% c.i. from 3.16 to 4.90				
Female DO	263	(128)	111	(246)
Male DO	860	(902)	658	(616)
OR=1.81; 95% c.i. from 1.42 to 2.31				
Female DO	263	(128)	111	(246)
Female MD	3,027	(3,102)	3,228	(3,153)
OR= 2.53; 95% c.i. from 2.02 to 3.18				
Female DO	263	(128)	111	(246)
Male MD	7,734	(7,848)	15,347	(15,233)
OR= 4.7; 95% c.i. from 3.69 to 5.99				
Male DO	860	(578)	658	(940)
Other Physician	11,024	(11,320)	18,686	(18,390)
OR=2.22; 95% c.i. from 2.00 to 2.46				
Female MD	3,027	(2,383)	3,228	(3,872)
Other Physician	8,857	(9,515)	16,116	(15,458)
OR= 1.71; 95% c.i. from 1.62 to 1.81				
Male MD	7,734	(8,794)	15,347	(14,287)
Other Physician	4,150	(3,104)	3,997	(6,043)
OR=0.49; 95% c.i. from 0.47 to 0.52				

In Texas 263 female DOs of interest practice primary care. The remaining three categories of doctors—male and female MDs, and male DOs--comprise the balance of the 11,884 primary care physicians in Texas. The probability of a female DO being a primary practice physician in Texas as of February 2003 is 70.3%. The probability of another physician type being a primary practice physician in Texas at the same time is 37.7%.

Calculating the odds ratio as ac/bd yields an OR of 3.92, or odds that a female osteopath is almost 4 times as likely to be a primary care physician than other physician types.The overall probability of being a primary practice physician in Texas as of February 2003 is 38.1%. Based on that probability the expected number of primary practice female osteopathic physicians falls to 142 (see table 9 for observed and expected values) with other values remaining close to observed values. Calculating the Yates-Corrected chi-square statistic for differences between the observed and expected values yields $X^2 = 166.88$, $p<0.0000$, significant at an alpha level of 0.99. Making further comparisons between female DOs and each specific category of "other physician" yields the following:

Female DOs vs. Male MDs:

When female osteopathic physicians are compared to male MDs from the same sample, an OR of 4.7, $p<0.0000$, is obtained, with the Yates-Corrected chi-square calculated as 217.36, significant beyond an alpha level of .999.

Female DOs vs. Female MDs:

When female osteopathic physicians are compared to female MDs from the same sample, an OR of 2.53 is obtained, with the Yates-Corrected chi-square calculated as 66.14, $p<0.0000$, significant beyond an alpha level of .999.

Female DOs vs. Male DOs:

When female osteopathic physicians are compared to male DOs from the sample, an OR of 1.81 is obtained, with the Yates-Corrected chi-square calculated as 22.89, $p<0.0000$, significant beyond an alpha level of .999.

Female MDs vs. All Other Types:

In Texas 3,027 female MDs of interest practice primary care. The remaining three categories of doctors—male MDs, and male and female DOs—comprise the balance of the 11,884 primary care physicians in Texas. The probability of a female MD being a primary practice physician in Texas as of February 2003 is 48.4%. The probability of another physician type being a primary practice physician in Texas at the same time is 35.5%. Calculating the odds ratio as ac/bd yields an OR of 1.71, or odds that a female allopathic physician from the sample is 1.7 times as likely as others from the sample to be a primary care physician. The overall probability of being a primary practice physician in Texas as of February 2003 is 38.1%. Based on that probability the expected number of primary practice female allopathic physicians falls to 2383, with other values remaining close to observed values. Calculating the Yates-Corrected chi-square statistic for differences between the observed and expected values yields $X^2 = 354.99$, $p<0.0000$, significant at an alpha level of 0.99.

Male MDs vs. All Other Types:

In Texas 7,734 male MDs of interest practice primary care. The remaining three categories of doctors—female MDs, and male and female DOs—comprise the balance of the 11,884 primary care physicians in Texas. The probability of a male MD being a primary practice physician in Texas as of February 2003 is 33.5%. The probability of another physician type being a primary practice physician in Texas at the same time is 34.9%. Calculating the odds ratio as ac/bd yields an OR of 0.49, or odds that a male allopathic physician from the sample is half as likely as other physician types to be a primary care physician. The overall probability of being a primary practice physician in Texas as of February 2003 is 38.1%. Based on that probability the expected number of primary practice male allopathic physicians rises to 8,794, with most other values remaining close to observed values. Calculating the Yates-Corrected chi-square statistic for differences between the observed and expected values yields $X^2 = 1{,}250.75$, $p<0.0000$, significant above an alpha level of 0.99.

Male DOs vs. All Other Types:

In Texas 860 male DOs of interest practice primary care. The remaining three categories of doctors—male and female MDs, and female DOs—comprise the balance of the 11,884 primary care physicians in Texas. The probability of a male DO being a primary practice physician in Texas as of February 2003 is 56.7%. The probability of another physician type being a primary practice physician in Texas at the same time is 37.1%.

Calculating the odds ratio as ac/bd yields an OR of 2.22, or odds that a male osteopathic physician from the sample is 2.22 times as likely as other physician types to be a primary care physician. The overall probability of being a primary practice physician in Texas as of February 2003 is 38.1%. Based on that probability the expected number of primary practice male osteopathic physicians falls to 578. Calculating the Yates-Corrected chi-square statistic for differences between the observed and expected values yields $X^2 = 233.86$, $p<0.0000$, significant above an alpha level of 0.99.

APPENDIX C

CALCULATIONS AND TABLES OF OBSERVED AND EXPECTED VALUES:

RURAL PRIMARY CARE

Female DOs vs. All Other Types:

In Texas 10 female DOs of interest practice primary care in a rural location. The remaining three categories of doctors—male and female MDs, and male DOs—comprise the balance of the 517 primary care physicians in rural Texas. The probability of a female DO being a rural primary practice physician in Texas as of February 2003 is 2.7%. The probability of another physician type being a primary practice physician in rural Texas at the same time is 1.7%. Calculating the odds ratio as ac/bd yields an OR of 1.64. The overall probability of being a primary practice physician in rural Texas as of February 2003 is 1.7%. Based on that probability the expected number of primary practice female osteopathic physicians falls to 6, with other values remaining close to observed values. See table 12 for observed and expected values. Calculating the Yates-Corrected chi-square statistic for differences between the observed and expected values yields $X^2 = 2.04$, with a p-value of 0.09921—not significant at an alpha level of 0.95. Making further comparisons between female DOs and each specific category of "other physician" yields the following:

Female DOs vs. Male MDs:

When female osteopathic physicians are compared to male MDs from the sample, an OR of 1.62 is obtained, with the Yates-Corrected chi-square calculated as 2.39, p=0.0982 not significant at the 95% confidence level.

Rural Primary Care Physicians in Texas, February 2003Observed Values (Expected Values)

	Rural Primary Care		Other	
	Observed	(Expected)	Observed	(Expected)
Female DO	10	(6)	364	(368)
Other Physician	507	(509)	30,347	(30,345)
OR=1.64; 95% c.i. from 0.87 to 3.09				
Female DO	10	(6)	364	(368)
Male DO	54	(52)	1,464	(1,466)
OR=0.745; 95% c.i. from 0.38 to 1.48				
Female DO	10	(6)	364	(368)
Female MD	68	(74)	6,187	(6,107)
OR=2.49; 95% c.i. from 1.27 to 4.88				
Female DO	10	(6)	364	(368)
Male MD	385	(388)	22,696	(22,693)
OR=1.62; 95% c.i. from 0.857 to 3.06				
Male DO	54	(27)	1464	(1,491)
Male MD	385	(415)	22,696	(22,666)
OR=2.17; 95% c.i. from 2.16 to 2.88				
Male DO	54	(25)	1464	(1493)
Other Physician	463	(492)	29,247	(29,218)
OR=2.33; 95% c.i. from 1.75 to 3.10				
Female MD	68	(104)	6,187	(6,151)
Other Physician	449	(413)	24,524	(24,559)
OR=0.60; 95% c.i. from 0.46 to 0.78				
Male MD	385	(382)	22,696	(22,699)
Other Physician	132	(135)	8,015	(8,018)
OR=1.03; 95% c.i. from 0.844 to 1.257				

Female DOs vs. Female MDs:

When female osteopathic physicians are compared to female MDs from the sample, an OR of 2.49 is obtained, with the Yates-Corrected chi-square calculated as 9.09, p=0.0011, significant at the 99.5% confidence level.

Female DOs vs. Male DOs:

When female osteopathic physicians are compared to male DOs from the sample, an OR of .745 is obtained, with the Yates-Corrected chi-square calculated as .542, p=0.0949, not significant at the 95% confidence level.

Female MDs vs. All Other Types:

In Texas 68 female MDs of interest practice primary care in a rural location. The remaining three categories of doctors—male and female DOs, and male MDs--comprise the balance of the 517 primary care physicians in rural Texas. The probability of a female MD being a rural primary practice physician in Texas as of February 2003 is 1.1%. The probability of another physician type being a primary practice physician in rural Texas at the same time is 1.7%. Calculating the odds ratio as ac/bd yields an OR of 0.60. The overall probability of being a primary practice physician in rural Texas as of February 2003 is 1.7%. Based on that probability the expected number of primary practice female allopathic physicians increases to 104, with other values remaining close to observed values.

Calculating the Yates-Corrected chi-square statistic for differences between the observed and expected values yields $X^2 = 15.42$, with a p-value = 0.0007--significant at an alpha level of 0.999.

Male MDs vs. All Other Types:

In Texas 385 male MDs of interest practice primary care in a rural location. The remaining three categories of doctors—male and female DOs, and female MDs--comprise the balance of the 517 primary care physicians in rural Texas. The probability

of a male MD being a rural primary practice physician in Texas as of February 2003 is an unrounded 1.668%. The probability of another physician type being a primary practice physician in rural Texas at the same time is very close—an unrounded 1.656. Calculating the odds ratio as ac/bd yields an OR of 1.03. The overall probability of being a primary practice physician in rural Texas as of February 2003 is 1.656%. Based on that probability the expected number of primary practice male allopathic physicians drops to 382. Calculating the Yates-Corrected chi-square statistic for differences between the observed and expected values yields $X^2 = 0.064$, p=0.762, not significant at an alpha level of .25 or less.

Male DOs vs. All Other Types:

In Texas 54 male DOs of interest practice primary care in a rural location. The remaining three categories of doctors—female DOs, and female and male MDs--comprise the balance of the 517 primary care physicians in rural Texas. The probability of a male DO being a rural primary practice physician in Texas as of February 2003 is 3.6%. The probability of another physician type being a primary practice physician in rural Texas at the same time is 1.6%. Calculating the odds ratio as ac/bd yields an OR of 2.33. The overall probability of being a primary practice physician in rural Texas as of February 2003 is 1.7%. Based on that probability the expected number of primary practice male osteopathic physicians drops to 25. Calculating the Yates-Corrected chi-square statistic for differences between the observed and expected values yields $X^2 =$ 34.22, p=0.0000, significant at an alpha level of .999.

When the confounding influence of primary care tendency is controlled, the calculations are similar to those reported above, but with comparisons made only within those practicing primary care (n=11,885).

APPENDIX D

DEFINITION OF TERMS

The following list of terms and phrases are used throughout the study:

Doctor of Osteopathy, DO, osteopath, or osteopathic physician—titles to indicate a physician who has received a medical degree from an accredited osteopathic medical college.

Doctor of Medicine, MD, allopath, or allopathic physician—titles to indicate a physician who has received a medical degree from an accredited allopathic medical college.

Licensed physician—phrase used to indicate physician of either type sanctioned by the Texas State Board of Medical Examiners to practice medicine in Texas.

Metropolitan and *non-metropolitan* counties--meaning areas defined by the OMB as those which meet criteria for urban and non-urban areas.

Non-metro, non-adjacent (nmna) or *rural* county--meaning counties defined by the federal Office of Management and Budget (OMB) as being both sparsely populated and geographically non-adjacent to a county which does not meet the criteria for being non-metro.

Physician of interest--meaning a physician that meets criteria to be included in analysis.

Primary care specialties or *primary care*--meaning the medical practice areas of family or general practice, pediatrics, or internal medicine.

REFERENCES

American Medical Association. (2001). *Physician Characteristics and Distribution in the US, 2001-2002*. Chicago: AMA Press.

American Osteopathic Association. (2003). *American Osteopathic Association fact sheet.* Retrieved June 21, 2003 from http://www.aoa-net.org/General/facts/202pdf.

American Osteopathic Association. (2003). *What is a DO?* Retrieved June 21, 2003 from http://www.aoa-net.org/Consumers/omed/htm.

Brooks, R.G., Salsberg, E., Phillips, D.M., Lishner, A. (2002). The roles of nature and nurture in the recruitment and retention of primary care physicians in rural areas: A review of the literature. *Academic Medicine, 77*, 790-798.

Brotherton, S.E., Simon, F.A., Etzel, S.I.(2002). US graduate medical education, 2001-2002: Changing dynamics. *Journal of the American Medical Association, 288*, 1073-1078.

Carvounis, C.P.. (2000). *Handbook of Biostatistics: A Review and Text.* Pearl River, New York: The Parthenon Publishing Group.

Council on Graduate Medical Education. (2000). *Resource paper compendium: Update on the physician workforce.* U.S. Department of Health and Human Services, Health Resources and Services Administration.

Denton, D.R., Cobb, J.H.; Webb, W.A.. (1989). Practice locations of Texas family practice residency graduates, 1979-1987. *Academic Medicine, 64*, 400-405.

Doescher, M.P., Ellsbury, K.E., Hart, G. (2000). The distribution of rural female generalist physicians in the United States. *Journal of Rural Health, 16*, 111-118.

Feldman, D. (2002). Is rural medicine for you? *Unique Opportunities: The Physician's Resource, 12*(5), 44-52.

Fink, K.S., Phillips, R.L. Jr., Fryer, G.E., Koehn, N. (2003). International medical graduates and the primary care workforce for rural underserved areas. *Health Affairs, 22*, 255-262.

Frenzen, P.D. (1991). The increasing supply of physicians in US urban and rural areas, 1975 to 1988. *American Journal of Public Health, 81*, 1141-1147.

Fryer, G.E., Stine, C., Vojir, C., Miller, M. (1997). Predictors and profiles of rural versus urban family practice. *Family Medicine, 29*, 115-118.

Geyman J.P., Hart, L.G., Norris, T.E., Coombs, J.B., Lishner, D.M. (2000). Educating generalist physicians for rural practice: how are we doing? *Journal of Rural Health, 16,* 56-80.

Glover, S.H. and Rivers, P.A. (2000). Strategic choices for a primary care advantage: Re-engineering osteopathic medicine for the 21st century. *Health Services Management Research, 13*, 156-163.

Hart, L.G., Salsberg, E., Phillips, D.M., Lishner, D.M. (2002). Rural health care providers in the United States. *Journal of Rural Health, 18* (Supplement), 211-232.

Hennekens, C.H., Burring, J.E.. (1987). *Epidemiology in Medicine*. Philadelphia: Lippincott Williams and Wilkins.

Hilsenrath, P., Lykens, K., Mains, D.. (2003). Physician supply: An economic and policy perspective. *Texas Journal of Rural Health, 21*, 16-29.

Howell, J.D., (1999). The paradox of osteopathy. *New England Journal of Medicine, 341*, 1465-1467.

Journal of the American Medical Association. (2002). Graduate medical education: Appendix II. *JAMA, 288*, 1151-1164.

Kuzma, J.W. (1992). *Basic Statistics for the Health Sciences, second edition.* Mountain View, CA: Mayfield Publishing Co.

Murdock, S.H. (2002). Estimates of the total populations of counties and places in Texas for July 1, 2002 and January 1, 2002.(table) *Texas State Data Center: The Texas State Population Estimates and Projections Program.* Department of Rural Sociology, Texas A&M University System, College Station, Texas

National Rural Health Association. (2003). NRHA policy brief: Rural graduate medical education. *National Rural Health Association*, retrieved June 18, 2003 from www.NRHArural.org.

National Rural Health Association. (2003). NRHA policy brief: Health care workforce distribution and shortage issues in rural America. *National Rural Health Association,* retrieved June 13, 2003 from www.NRHArural.org.

National Rural Health Association. (1998). Physician recruitment and retention. National Rural Health Association, retrieved June 15, 2003 from www.NRHArural.org.

Naughton, J. (1998). The Changing Nature of Health Professions Education. In Longest, BB, Jr. (Ed.), *Contemporary Health Policy* (pp. 351-382). Chicago, Illinois and Washington, DC: AUPHA/Health Administration Press.

Office of Rural Health Policy (2003). Rural health research in progress, March, 2003, 7th Edition. *Office of Rural Health Policy, U.S. Department of Health and Human Services.*

Pew Health Professions Commission. (1995). Critical challenges: Revitalizing the health professions of the twenty-first century. *Pew Health Professions Committee.*

Pugno, P., Schmittling, G.T., McPhereson, D.S., Kahn, N.B. Jr. (2000). Entry of US medical graduates into family practice residencies: 1999-2000 and 3-year summary. *Family Medicine, 32,* 534-542.

Rabinowitz, H.K., Diamond, J.J., Markham, F.W., Hazelwood, C.E. (1999). A program to increase the number of family physicians in rural and underserved areas: Impact after 22 years. *JAMA, 281,* 255-260.

Rabinowitz, H.K., Diamond, J.J., Markham, F.W., Paynter, N.P. (2001). Critical factors for designing programs to increase the supply and retention of rural primary care physicians. *JAMA, 286,* 1041-1048.

Rabinowitz, H.K., Paynter, N.P. (2000). The role of the medical school in rural graduate medical education: Pipeline or control valve? *Journal of Rural Health, 16,* 249-253.

Rabinowitz, H.K., Whitcomb, M., Cullen, T., Lishner, D., Hart, J.A. (2000). The impact of multiple predictors on generalist physicians' care of underserved populations. *American Journal of Public Health, 90,* 1225-1228.

Ricketts, T.C., Hart, L.G., Pirani, M.. (2000). How many rural doctors do we have? *Journal of Rural Health, 16,* 198-207.

Roberts, A., Foster, R.., Dennis, M., Davis, L., Wells, J., Bodemuller, M.F., Bailey, C.A.. (1993). An approach to training and retaining primary care physicians in rural Appalachia. *Academic Medicine, 68,* 122-125.

Rosenblatt, R., Whitcomb, M., Cullen, T., Lishner, D., Hart, G. (1992). Which medical schools produce rural physicians? *JAMA, 268,* 1559-1565.

Rosenblatt, R., Hart. G. (2000). Physicians and rural America. *Western Journal of Medicine, 73,* 348-351.

Rosner, B. (2000). *Fundamentals of Biostatistics, 5th Edition.* Duxbury. Pacific Grove, CA.

Rural Policy Research Institute. (2000). Rural policy context: Metropolitan and non-metropolitan counties: Definitions from the U.S. Office of Management and Budget. *Rural Policy Research Institute*, Retrieved October 20, 2002 from http://www.rupri.org/policyres/context/omb.html.

Simpson, C., Simpson, M.A. (1994). Complexity of the healthcare crisis in rural America. *Journal of the American Osteopathic Association, 94*, 502-508.

Simpson, M.A., Wieser, M.(1996). Studying the impact of women on osteopathic physician workforce predictions. *Journal of the American Osteopathic Association, 96*, 106-111.

Singer, AM. (2003). 2002 Annual report on osteopathic medical education. *American Osteopathic Organization*. Retrieved July 25,2003 from http://www.aacom.org/data/annualreport/index.html.

Texas Department of Health. (2002). The health of Texas: Texas state strategic health plan, part 1. Texas Department of Health, Austin, TX.

Texas State Board of Medical Examiners. (2003) Complete electronic database, February 2003 edition. *Texas State Board of Medical Examiners*, Austin, TX.

Texas State Board of Medical Examiners. (2003). Physicians in and out of State, January 2003. *Texas State Board of Medical Examiners*, Retrieved February 2, 2003 from http://www.tsbme.state.tx.us/demo/docs/d2003/0103/inout.htm.

Texas State Board of Medical Examiners. (2003). Physicians by Gender and County, January 2003. *Texas State Board of Medical Examiners*, Retrieved February 2, 2003 from http://www.tsbme.state.tx.us/demo/docs/d2003/0103/inout.htm.

Texas State Data Center and Office of the State Demographer. (2002). Texas County Cross-Reference , *Texas State Data Center and Office of the State Demographer, Texas A&M University Department of Rural Sociology, College Station, Texas,* Retrieved February 2, 2003 from http://www.txsdc.tamu.edu/reference/georef/county_master.php

Texas State Data Center and Office of the State Demographer. (2002). Metropolitan Statistical Areas. *Texas State Data Center and Office of the State Demographer, Texas A&M University Department of Rural Sociology, College Station, Texas,* Retrieved June 3, 2003 from http://www.txsdc.tamu.edu/reference/georef/county_master.php.

Tooke-Rawlins, D. (2000). Rural osteopathic family physician supply: Past and present. *Journal of Rural Health, 16*, 299-300.

United States Census Bureau. (2002). Census 2000 Data for Texas. *United States Department of Commerce, Public Information Office*, Retrieved on June 1, 2003 from http://www.census.gov/census2000/states/tx.html.

U.S. Census Bureau. (2002). Population, housing units, area, and density: 2000. *United States Department of Commerce, Public Information Office,* Retrieved on June 1, 2003 from http://www.census.gov/census2000/states/tx.html.

West, P.A., Norris, T.E., Gore, E.J., Baldwin, L.M., Hart, L.G. (1996). The geographic and temporal patterns of residency-trained family physicians: University of Washington Family Practice Residency Network. *Journal of the American Board of Family Practice*, *9*, 100-108.