

Final Report #137

**Understanding  
Advanced Practice  
Registered Nurse  
Distribution in  
Urban and Rural  
Areas of the United  
States Using  
National Provider  
Identifier Data**

February 2012

This study was funded through a contract  
with the American Nurses Association.



by

Susan M. Skillman, MS

Louise Kaplan, PhD, ARNP,  
FNP-BC, FAANP

Meredith A. Fordyce, PhD

Peter D. McMenamin, PhD

Mark P. Doescher, MD, MSPH

UNIVERSITY OF WASHINGTON  
SCHOOL OF MEDICINE  
DEPARTMENT OF FAMILY MEDICINE

## CONTENTS

Executive Summary.....	3	Limitations .....	15
Introduction.....	5	Conclusions .....	16
Methods.....	6	Implications for Policy and Practice.....	16
Findings.....	7	References .....	17
		Appendix A.....	19

## ABOUT THE CENTER

The WWAMI Rural Health Research Center (RHRC) is one of six centers supported by the Federal Office of Rural Health Policy (FORHP), a component of the Health Resources and Services Administration (HRSA) of the U.S. Public Health Service. The major focus of the RHRC is to perform policy-oriented research on issues related to rural health care and the rural health professional workforce. Specific interests of the RHRC include the adequacy of the supply and education of rural health care professionals, and the availability and quality of health care for rural populations, with particular emphasis on access to high-quality care for vulnerable and minority rural populations.

The WWAMI Rural Health Research Center is based in the Department of Family Medicine at the University of Washington School of Medicine, and has close working relationships with the WWAMI Center for Health Workforce Studies, state offices of rural health, and the other health science schools at the University, as well as with other major universities in the five WWAMI states: Washington, Wyoming, Alaska, Montana, and Idaho. The University of Washington has over 30 years of experience as part of a decentralized educational research and service consortium involving the WWAMI states, and the activities of the RHRC are particularly focused on the needs and challenges in these states.

The Rural Health Final Report Series is a means of distributing prepublication articles and other working papers to colleagues in the field. Your comments on these papers are welcome, and should be addressed directly to the authors. Questions about the WWAMI Rural Health Research Center should be addressed to:

Mark P. Doescher, MD, MSPH, Director  
Susan M. Skillman, MS, Deputy Director  
WWAMI Rural Health Research Center  
Department of Family Medicine  
School of Medicine  
University of Washington  
Box 354982  
Seattle, WA 98195-4982  
E-mail: [rhrc@fammed.washington.edu](mailto:rhrc@fammed.washington.edu)  
WWW: <http://depts.washington.edu/uwrhrc/>

## ABOUT THE AUTHORS

**SUSAN M. SKILLMAN, MS**, is the Deputy Director of the WWAMI Rural Health Research Center, Department of Family Medicine, University of Washington School of Medicine.

**LOUISE KAPLAN, PhD, ARNP, FNP-BC, FAANP**, was a Senior Policy Fellow at the American Nurses Association at the time this study was conducted.

**MEREDITH A. FORDYCE, PhD**, is an Investigator in the WWAMI Rural Health Research Center, University of Washington School of Medicine.

**PETER D. MCMENAMIN, PhD**, is a Health Economist and Senior Policy Fellow at the American Nurses Association.

**MARK P. DOESCHER, MD, MSPH**, is the Director of the WWAMI Rural Health Research Center and an Associate Professor in the Department of Family Medicine, University of Washington School of Medicine.

# Understanding Advanced Practice Registered Nurse Distribution in Urban and Rural Areas of the United States Using National Provider Identifier Data

SUSAN M. SKILLMAN, MS

LOUISE KAPLAN, PhD, ARNP, FNP-BC, FAANP

MEREDITH A. FORDYCE, PhD

PETER D. MCMENAMIN, PhD

MARK P. DOESCHER, MD, MSPH

## EXECUTIVE SUMMARY

### INTRODUCTION

Information on the distribution of the advanced practice registered nurse (APRN) workforce supply is needed to help workforce planners and policymakers address current and anticipated shortages effectively. The goal of this study was to examine the 2010 Centers for Medicare and Medicaid Services National Plan and Provider Enumeration System's National Provider Identifier (NPI) data to determine their usefulness for studying the distribution of advanced practice registered nurses (APRNs) in rural and urban areas of the United States. Where the data were determined to be sufficiently complete, another study goal was to compare APRN rural and urban distribution and identify factors associated with rural practice location.

### METHODS

This study analyzed individual NPI records from the 2010 NPI data set to identify the urban and rural location in the United States of all APRNs, which includes nurse practitioners (NPs), certified registered nurse anesthetists (CRNAs), certified nurse-midwives (CNMs), and clinical nurse specialists (CNSs). Overall NPI provider counts were compared with other national data sets and professional association data to assess the extent to which the NPI data set represents the

total number of APRNs in the United States. Per capita provider supply was determined using 2011 Neilson/Claritas population estimates based on U.S. census data. Rural-urban APRN location was determined by linking Rural-Urban Commuting Area codes to NPI provider ZIP codes. Chi-square testing examined provider supply by geographic locations. Multivariate hierarchical regression testing identified whether rural location was related to practice autonomy, per capita provider supply, or gender.

### KEY FINDINGS

This study found 152,185 APRNs with NPIs in the United States, of which 106,113 were NPs, 35,973 were CRNAs, 5,187 were CNMs, and 4,912 were CNSs. The numbers of CNMs and CNSs in the data set were determined to be too small to represent those APRN populations and were dropped from further analyses. Overall there were 3.6 urban and 2.8 rural NPs per 10,000 population. Only three states had the same or more rural NPs than urban NPs per capita. In multivariate hierarchical models, the relative risk of being in a rural location was higher (but not significantly) for NPs in states with the most autonomous practice regulations (RR 1.5,  $P = 0.075$ ) compared with states requiring physician delegation or supervision. The likelihood of rural location was higher for male NPs (RR 1.2,  $P < 0.0001$ ): 8.9% of rural NPs were male compared with 6.8% of urban NPs. The

NPI data set included records for 35,973 individual CRNAs, with a distribution of 1.2 urban and 0.9 rural CRNAs per 10,000 population. In 17 states, the per capita number of CRNAs with NPIs was the same or larger in rural areas compared with urban areas. In multivariate hierarchical models of the CRNA sample, the relative risk of being in a rural location was higher for CRNAs in states with the most autonomous practice regulations (RR 2.0,  $P < 0.001$ ) compared with states with no prescriptive authority, and for male CRNAs (RR 1.9,  $P < 0.0001$ ). Men comprised 60.9% of rural and 38.5% of urban CRNAs.

## DISCUSSION

This study showed that CRNAs were more likely to practice in rural areas in states with greater practice autonomy. For NPs, the findings were similar but were of borderline statistical significance. In

addition, male NPs and CRNAs were more likely than females to be in rural locations. These findings imply that practice autonomy should be considered as a state-level strategy to encourage rural practice by NPs and CRNAs. In addition, efforts to encourage more men to choose careers as NPs or CRNAs would likely benefit rural communities. The NPI could become an even more valuable tool for national health workforce planning if all relevant providers obtained an NPI and if all were to update their records regularly. Further research is needed to understand factors that influence NPs' and CRNAs' decisions to practice in rural areas.

---

# Understanding Advanced Practice Registered Nurse Distribution in Urban and Rural Areas of the United States Using National Provider Identifier Data

SUSAN M. SKILLMAN, MS

LOUISE KAPLAN, PhD, ARNP, FNP-BC, FAANP

MEREDITH A. FORDYCE, PhD

PETER D. MCMENAMIN, PhD

MARK P. DOESCHER, MD, MSPH

## INTRODUCTION

### BACKGROUND

Workforce projections indicate looming primary care provider shortages, especially in rural areas. Implementation of the Patient Protection and Affordable Care Act is estimated to provide approximately 32 million additional people with health insurance beginning in 2014. While many of these people already use the healthcare system, it is likely they will need and use an increasing amount of primary and specialty care services.

Advanced practice registered nurses (APRNs) are important contributors to the health workforce. APRNs include nurse practitioners (NPs), certified nurse-midwives (CNMs), certified registered nurse anesthetists (CRNAs), and clinical nurse specialists (CNSs). Many NPs and CNMs provide primary care, while CNSs typically provide specialty care.

Having information on the distribution of APRN workforce supply would help planners and policymakers address anticipated shortages effectively. There are, however, few data regarding the amount of primary care provided by APRNs and their geographic distribution. According to the 2009-2010 American Academy of Nurse Practitioners National Nurse Practitioner Survey, the majority (79.7%) of respondents worked in community-based settings where primary care is provided, such as private offices, outpatient hospital clinics, rural health centers, and community health centers. Almost 18% of survey respondents also reported working in rural communities with populations fewer than 25,000.<sup>1</sup> A 2006 survey of Washington State NPs and CNMs revealed that 73% of respondents provided some

primary care services and 34% exclusively provided primary care (L. Kaplan and M. A. Brown, unpublished data, 2007). Eleven percent of the respondents worked in rural areas.<sup>2</sup>

### THE NATIONAL PROVIDER IDENTIFIER (NPI)

One purpose of the Health Insurance Portability and Accountability Act of 1996 (HIPAA) was administrative simplification. The National Provider Identifier (NPI) was created to uniquely identify a healthcare provider in standard transactions, such as healthcare claims. NPIs may also be used in a variety of ways such as to identify healthcare providers on prescriptions, in coordination of benefits between health plans, in patient medical record systems, and in program integrity files. HIPAA requires that health plans, healthcare clearinghouses, and healthcare providers must use the NPI for administrative and financial transactions covered under HIPAA. The NPI, a 10-digit number, is a record within the National Plan and Provider Enumeration System (NPPES) that covers both individuals such as APRNs and institutional providers such as hospitals. APRNs who directly bill Medicare, Medicaid, and some health insurers for services using electronic billing must obtain and use an NPI. As of March 2010, there were 152,608 individual APRNs in the United States who had active NPIs.

### PURPOSE

The purposes of this study were to examine national NPI data for APRNs to assess the extent to which they can be used to quantify and to describe the distribution of APRNs across the United States. The number of NPs, CRNAs, CNMs, and CNSs were analyzed to determine which appeared to be fully represented in the

NPES data set (hereafter referred to as the NPI data set). Because there were sufficient numbers of NPs and CRNAs in the NPI data, this study analyzed their distribution among urban and rural areas of the United States and examined characteristics of the providers and their states that might be associated with practice in rural areas.

## METHODS

### NPI DATA

Staff from the American Nurses Association (ANA) extracted data from the March 2010 NPI data set available from the website of the Centers for Medicare and Medicaid Services (CMS).<sup>3,4</sup> The NPI requires providers to identify their provider type (i.e., physician, nurse practitioner, registered nurse) and allows specification of their specialty and subspecialty using a coding system called the Health Care Provider Taxonomy Code Set, which is maintained by CMS.<sup>5</sup> These codes can be recorded in one or more of the 15 “taxonomy” fields when applying for an NPI number. APRNs may be identified among all NPI holders using the first four characters of the 10-character taxonomy identifier.

The subset of the NPI data set prepared by ANA staff contained all variables found in the original NPI data file for cases that indicated at least one APRN taxonomy. Each record was assigned to one of the four APRN roles (NP, CRNA, CNM, or CNS). There were 162,610 cases in the original file prepared by ANA staff, of which 152,608 were individual APRNs and 10,002 were organizations that identified the presence of an APRN. Of these cases, 431 were excluded because their practice location was outside the United States (including in U.S. territories or associated with military or diplomatic practice addresses outside the United States) or had a practice state that did not match the state of their practice ZIP code. This left a total of 162,179 APRNs of whom 152,185 (93.8%) were individual and 9,994 (6.2%) were organizational. For purposes of this study, only data for individual APRNs were analyzed. Of the individual APRNs, 106,113 (69.7%) were NPs (four-character designation “363L”), 35,973 (23.6%) were CRNAs (“3675”), 5,187 (3.4%) were CNMs (“367A”), and 4,912 (3.2%) were CNSs (“364S”).

Data for organizational NPIs were excluded for several reasons. Organizations are allowed to identify up to 15 provider types but do not report how many providers of a particular type are represented by the organization’s listed taxonomies. It is also unknown how many of the providers listed under an organization’s umbrella have their own individual NPI, raising the possibility of double-counting between individuals and organizations. Furthermore, an APRN may be working

part time at more than one organization. Uncertainties of this kind make using organizations as a unit of analysis problematic.

### PRACTICE AUTONOMY

APRN scope of practice is defined by laws and regulations on a state-by-state basis. These vary widely, with some APRNs practicing in states with full statutory autonomy (including prescriptive authority) while others practice in states that restrict practice by requiring collaboration with or supervision by a physician, or delegation of practice authority. Prescribing laws also range from full statutory authority for legend and controlled drugs, to a requirement for collaboration with or supervision by a physician, to delegation of prescriptive authority and limited or no controlled substance prescribing. Many laws are specific and detailed while others are vague and subject to interpretation.

In some instances APRNs may not take advantage of a law. In 2001, Washington State implemented a law that allowed APRNs to prescribe Schedule II-IV controlled substances if they had a joint practice agreement with a physician. Between the time of the implementation and 2005 when the requirement for a joint practice agreement was eliminated, only 60% of APRNs obtained the authority to prescribe these drugs. Among CRNAs, in Washington only 40% of respondents to a statewide survey reported having prescriptive authority and 11% did not have Drug Enforcement Administration registration, which is needed to prescribe controlled substances. Most CRNAs used a provision of the nurse practice act that authorizes them, subject to facility protocol, to select, order, and administer medication.<sup>6</sup> As another example, CRNAs in Louisiana have prescriptive authority, yet in 2009 only one out of 1,200 had applied and received it (P. Greiner, Louisiana State Board of Nursing, personal communication, December 17, 2008).

States were classified into three groups based on state laws and regulations in 2010. For NPs, the three categories were (1) the states in which there is full statutory autonomy, including Maine where supervision is required for two years before full autonomy is obtained and Utah where a consultation and referral plan is needed to prescribe Schedule II and III drugs; (2) states in which collaboration with a physician is required for either or both practice and prescriptive authority; and (3) states in which NPs must have physician supervision or where practice authority or prescriptive authority is delegated. Table 1 shows the three NP autonomy categories and states that fall within each.

For CRNAs three groupings were created based on research conducted by Kaplan, Brown, and Simonson (2011).<sup>6</sup> States in which prescriptive authority is

authorized but CRNAs do not apply for it, such as Louisiana and Arkansas, were classified as not having prescriptive authority. The three CRNA categories were: (1) autonomous; (2) collaboration with, supervision by, or delegation from a physician; and (3) no prescriptive authority or prescriptive authority is not used. Table 1 shows the three CRNA autonomy categories and states that fall within each.

## RURAL GEOGRAPHY

APRNs' primary practice locations were identified using ZIP codes, to which Rural Urban Commuting Area (RUCA) codes, version 2.0, were linked. RUCA codes define locations with more precision than county-based taxonomies. RUCA codes classify ZIP codes into 33 categories according to core population and work commuter flow patterns.<sup>7</sup> RUCAs were categorized into urban, large rural, small rural, and isolated small rural areas. These groupings have been used in other similar studies of the health workforce.<sup>8-10</sup> Both population size and communities' functional connections to larger areas were taken into account by using RUCAs to characterize rural area types. The RUCA codes assigned to each category were: urban = 1.0, 1.1, 2.0, 2.1, 3.0, 4.1, 5.1, 7.1, 8.1, and 10.1; large rural = 4.0, 4.2, 5.0, 5.2, 6.0, and 6.1; small rural = 7.0, 7.2, 7.3, 7.4, 8.0, 8.2, 8.3, 8.4, 9.0, 9.1, and 9.2; isolated small rural = 10.0, 10.2, 10.3, 10.4, 10.5, and 10.6.

Per capita levels of APRNs, were calculated by state, within rural versus urban areas, as well as among large rural, small rural, and isolated small rural areas. The denominators were based on ZIP code-level 2011 population data obtained from Neilson/Claritas, a commercial organization that supplies U.S. demographic data derived from U.S. census data.<sup>11</sup>

## FACTORS ASSOCIATED WITH RURAL PROVIDER LOCATION

With the individual as the unit of analysis, multivariate hierarchical regressions were conducted to assess the level of autonomy associated with practice in a rural area. Regressions controlled for one individual variable (practitioner gender, with females as the reference category) and one contextual variable (practitioner supply, as measured by number per 10,000 state population). The Zhang and Yu adjustment was used to calculate relative risks and confidence intervals from odds ratios.<sup>12</sup> For NPs and CRNAs, the autonomy categories were constructed based on state regulations regarding the type of statutory authority. As described above, for NPs, the categories were (1) fully autonomous or autonomous with condition, (2) collaboration, and (3) delegation or supervision, with the latter category being the reference. For CRNAs, the categories were (1) fully autonomous, (2) collaboration or supervision, and (3) no prescriptive authority, the reference category.

## FINDINGS

### APRNS OVERALL: USING NPI DATA FOR ESTIMATES OF NP, CRNA, CNM, AND CNS WORKFORCE SUPPLY

The analyses identified 152,185 APRNs in the United States as a whole, after excluding cases with practice locations located outside the United States or for whom the practice location contained conflicting information. Among these, 106,113 were identified as NPs, 35,973 as CRNAs, 5,187 as CNMs, and 4,912 as CNSs.

**Table 1. NP and CRNA Practice Autonomy Categories by State**

Practice Autonomy Categories*	States
<b>NPs</b>	
Autonomous	AK, AZ, DC, ID, IA, ME, MT, NH, NM, OR, RI, UT, WA, WY
Collaboration	AL, AR, CA, CO, CT, DE, HI, IN, KS, KY, LA, MD, MS, ND, NJ, NV, NY, OH, PA, SD, VT, WV
Delegation/supervision	GA, IL, FL, MA, MI, MN, MO, NE, NC, OK, SC, TN, TX, WI, VA
<b>CRNAs</b>	
Autonomous	AZ, DC, IA, MT, NH, NM, RI, WA, WY
Collaboration, supervision, or delegation	AK, CO, CT, DE, ID, IL, KY, MN, MO, NJ, OK, TN, TX, VT, WV, WI
No prescriptive authority/authority not used	AL, AR, CA, FL, GA, HI, IN, KS, LA, ME, MA, MD, MI, MS, NE, NC, ND, NV, NY, OH, OR, PA, SC, SD, UT, VA

\*Extent to which collaboration, supervision, or delegation is required by state law or regulation.

**NPs:** Currently there is no national federal data set that is considered to be representative of the entire NP population in the United States. The Health Resources and Services Administration is planning a national sample survey of NPs in 2012. The 2008 National Sample Survey of Registered Nurses (NSSRN) estimates there were 158,348 nurses with NP preparation, including 19,134 prepared both as NPs and CNSs or CNMs.<sup>13</sup> Among all NPs, the NSSRN estimates that 138,186 were employed in nursing in 2008. The American Academy of Nurse Practitioners maintains a database of NPs that is updated each year by obtaining data from state boards of nursing. After eliminating duplicates among states, in 2010 that database included records of approximately 140,000 NPs from which AANP conducts periodic surveys.<sup>14,15</sup> The number of NPs identified in the NPI data set was 78% of the number reported by the NSSRN for 2008, and 76% of the number reported by the AANP in 2010. The NPI data should largely represent practicing NPs and therefore be a subset, but still a majority, of the number of licensed NPs. From these comparisons, it was determined that the NPI data set likely undercounts total practicing NP supply. This may be because some NPs use an organization rather than an individual NPI and may not have obtained an NPI. For purposes of this study of the distribution of NPs, however, further analyses using the NPI data set were determined to be worthwhile.

**CRNAs:** A staff member of the American Association of Nurse Anesthetists was contacted who confirmed the number of CRNAs was similar to their estimate of the national number of CRNAs. The NSSRN estimated there were 34,821 CRNAs in 2008,<sup>13</sup> which is slightly lower than the 35,973 identified in the 2010 NPI database. Between the 2008 survey and when the NPI data were accessed in 2010, the number of CRNAs likely increased. Based on these comparisons, it was determined that the CRNA data from the NPI appeared representative of the national population of practicing CRNAs.

**CNMs:** The American Midwifery Certification Board (AMCB) indicated that in 2011 there were 10,332 CNMs in the United States (C. D. Bright, Executive Director, AMCB, personal communication, October 17, 2011). After taking this into account, the number of CNMs found in the NPI data (5,187 or 50% of the AMCB number) was determined to significantly undercount national CNM supply, and therefore no further evaluation of CNM workforce distribution was pursued.

**CNSs:** CNSs are not licensed or recognized by statute or regulation in all states. Consequently, nurses educated as CNSs may refer to themselves as such without legal recognition. The NSSRN

estimated there were nearly 60,000 CNSs, of which a little more than 20,000 were estimated to have state board recognition.<sup>13</sup> With only 4,912 CNSs in the NPI database, and no way to evaluate their representativeness of the total CNS population, it was determined that no meaningful analysis could be conducted with these data.

## NURSE PRACTITIONER SUPPLY

### Number and Distribution of NPs in the United States Based on NPI Data

In the United States overall, 106,113 NPs listed in the March 2010 NPI data file were identified, after exclusions as described above. The national per capita ratio of all NPs to 10,000 population was 3.4. The overall per capita figures at the state level ranged from a low of 1.7 in Nevada to the high of 8.7 in Washington, DC (Appendix A, Table A-1). The state with the fewest NPs was Wyoming (n = 190), and states with the largest numbers of NPs were New York (n = 8,779) and California (n = 8,458).

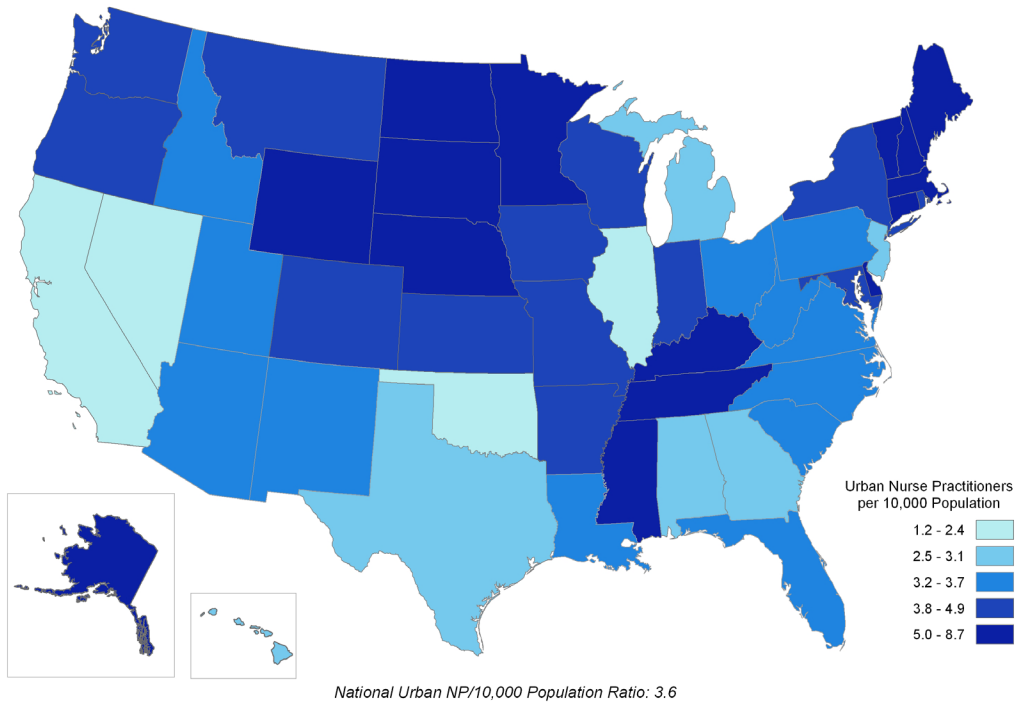
**Urban NPs:** Nationally, 89,947 (84.8%) of the 106,113 total NPs in 2010 indicated they were practicing in urban places. This represented a national urban per capita ratio of 3.6 NPs per 10,000 population. At the state level, there was considerable variation in the total numbers of urban NPs (see Appendix A, Table A-1). Some states in the Southwest, West, and Southeast had the lowest urban NP ratios, with Nevada (1.7/10,000), Oklahoma (2.0/10,000), Illinois (2.2/10,000), and California (2.3/10,000) having the lowest in the nation (see Figure 1). The highest per capita ratios of urban NPs were located, for the most part, in New England, the upper Midwest and a small portion of the South. Washington, DC (8.7/10,000), and Maine (8.0/10,000) had the highest urban NP-per-capita ratios. New York (n = 7,986) and California (n = 7,899) had the most urban NPs, and Wyoming (n = 90) and Vermont (n = 120) had the fewest.

**Rural NPs:** Of all NPs nationally, 16,166 (15.2%) were practicing in rural locations. The national per capita ratio of rural NPs was 2.8 per 10,000 population, which is roughly three quarters of the per capita supply of urban RNs reported above. Washington, DC, and Rhode Island have no rural areas, as defined by the RUCA rural/urban coding taxonomy, so no results are reported for these locations.

At the state level, those states with the highest rural NP per capita ratios were generally found in New England, the Northwest, and the South Central portions of the United States and the lowest ratios in the Southwest, Southeast, and Midwest (see Figure 2 and Appendix A, Table A-1). The states with the lowest rural NP ratios were Nevada (1.2/10,000), Utah (1.5/10,000), Texas (1.7/10,000), Ohio (1.8/10,000), and Oklahoma

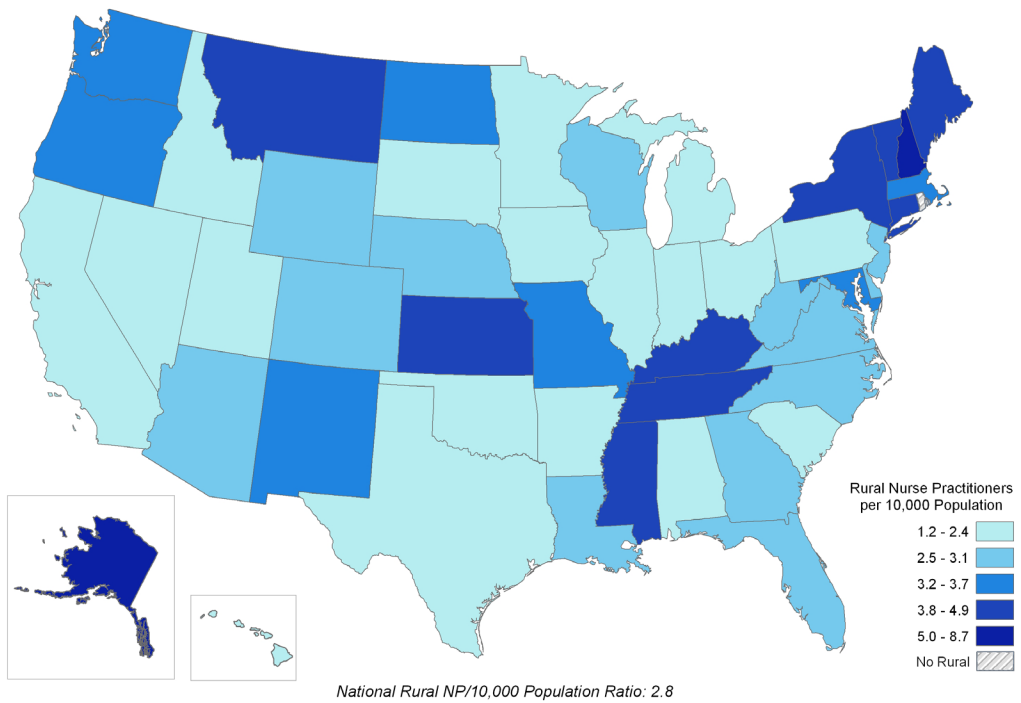


**Figure 1: Urban NPs per 10,000 State Population, 2010 NPI Data**



Map Date: November 2011  
 Data Sources: March 2010 National Plan and Provider Enumeration system (NPPES) data file, 2011 Neilson/Claritas Population Estimates

**Figure 2: Rural NPs per 10,000 State Population, 2010 NPI Data**



Map Date: November 2011  
 Data Sources: March 2010 National Plan and Provider Enumeration system (NPPES) data file, 2011 Neilson/Claritas Population Estimates

(1.8/10,000). Those having the highest ratios were New Hampshire (7.7/10,000) and Alaska (5.2/10,000). Only three states (New Hampshire, New Jersey, and Illinois) had the same or greater rural than urban per capita NPs with NPIs. The number of rural NPs ranged from the lowest in Nevada (n = 33), New Jersey (n = 35), and Utah (n = 51) to the highest in Kentucky (n = 808), Mississippi (n = 812), New York (n = 793), and Tennessee (n = 792) (Appendix A, Table A-1).

Figure 3 illustrates the variation that exists among per capita ratios of urban NPs by state and rural NPs by state. The figure is color coded by descending order of state rural per capita ratios.

**NPs Within Rural Areas:** Among all rural NPs in the United States, 57.5% (9,301) were in large rural areas, 26.0% (4,210) in small rural areas, and 16.4% (2,655) in isolated small rural areas. The number of NPs per 10,000 population in 2010 declined as “rurality” increased (3.1, 2.6, and 2.2/10,000 for large, small, and isolated small rural areas, respectively). These details and state-level findings can be found in Appendix A, Table A-2.

**NPs in U.S. Regions:** Regional analyses of the 106,113 NPs in 2010 showed that 23,912 (22.5%) were in the Northeast region, 22,952 (21.6%) in the Midwest, 38,522 (36.3%) in the South, and 20,727

(19.5%) in the West. Among the three rural categories, regional analyses consistently showed that smaller and more isolated areas consistently had proportionately fewer NPs.

### Factors Associated with NP Rural Practice

The study examined the relationship between state- and individual-level characteristics of NPs and the relative risk of NP practice in a rural area. These factors included the degree of practice autonomy and number of NPs per 10,000 state population and NP gender. In the unadjusted and adjusted analyses, NPs working in states with the greatest practice autonomy (among three categories) had somewhat higher relative risk of practicing in a rural location compared with NPs working in states with supervision or delegated authority; this difference approached, but did not quite meet, the  $P < 0.05$  cutoff for statistical significance (Table 2).

As shown in Table 3, the percentage of male NPs was larger in rural areas than in urban areas (8.9% rural compared with 6.8% urban). The relative risk of rural practice was greater for male NPs than females (RR 1.23,  $P < 0.0001$ ). The overall state NP supply (number of NPs per 10,000 population) was not significantly associated with greater likelihood of NP practice in rural areas.

**Table 2. Relative Risk of NP Rural Practice Location by Level of Practice Autonomy and Association with Individual and State Characteristics: 2010 NPI Data**

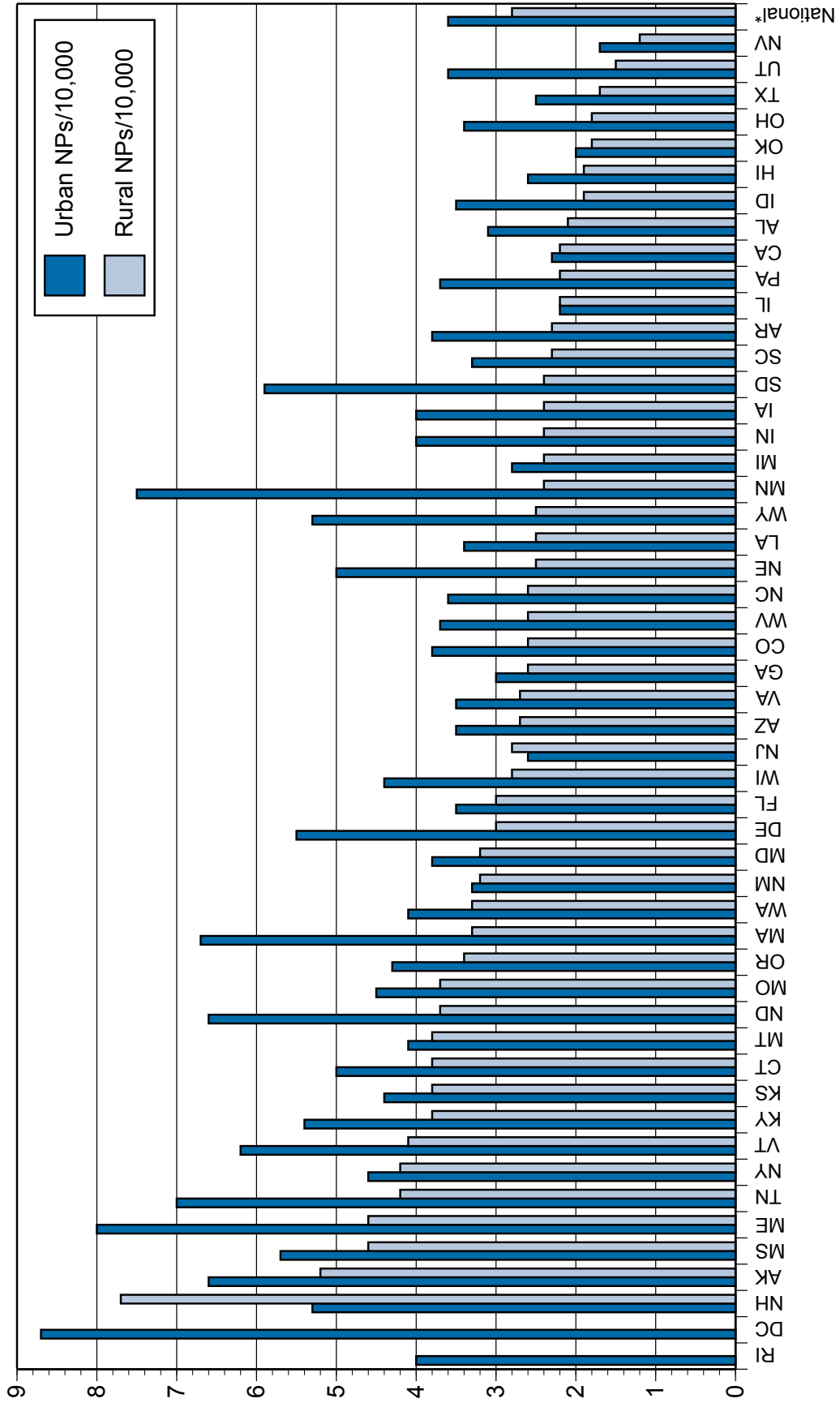
Autonomy Category*	Unadjusted (Rural Practice)		Adjusted for Gender and Per Capita NP Supply	
	Relative Risk (CI)	P Value	Relative Risk (CI)	P Value
Fully autonomous and autonomous with condition	1.50 (0.97-2.15)	0.066	1.49 (0.96-2.13)	0.075
Collaboration	1.04 (0.63-1.79)	0.867	1.07 (0.65-1.69)	0.775

\*Reference category = delegation and supervision.

**Table 3. Number and Percent of Male NPs Overall and in Urban, Rural, and Sub-rural Areas of the United States: 2010 NPI Data**

	Total (n = 106,113)	Urban (n = 89,947)	Rural (n = 16,166)	Sub-rural Areas		
				Large Rural (n = 9,301)	Small Rural (n = 4,210)	Isolated Small Rural (n = 2,655)
Male NPs	7,589	6,157	1,432	825	378	229
Percent male	7.2%	6.8%	8.9%	8.9%	9.0%	8.6%

Figure 3: Rural and Urban NPs per 10,000 Population by State, 2010 NPI Data



\* Overall national rural NPs/10,000: 2.8.

## CRNAS

### Number and Distribution of CRNAs in the United States Based on NPI Data

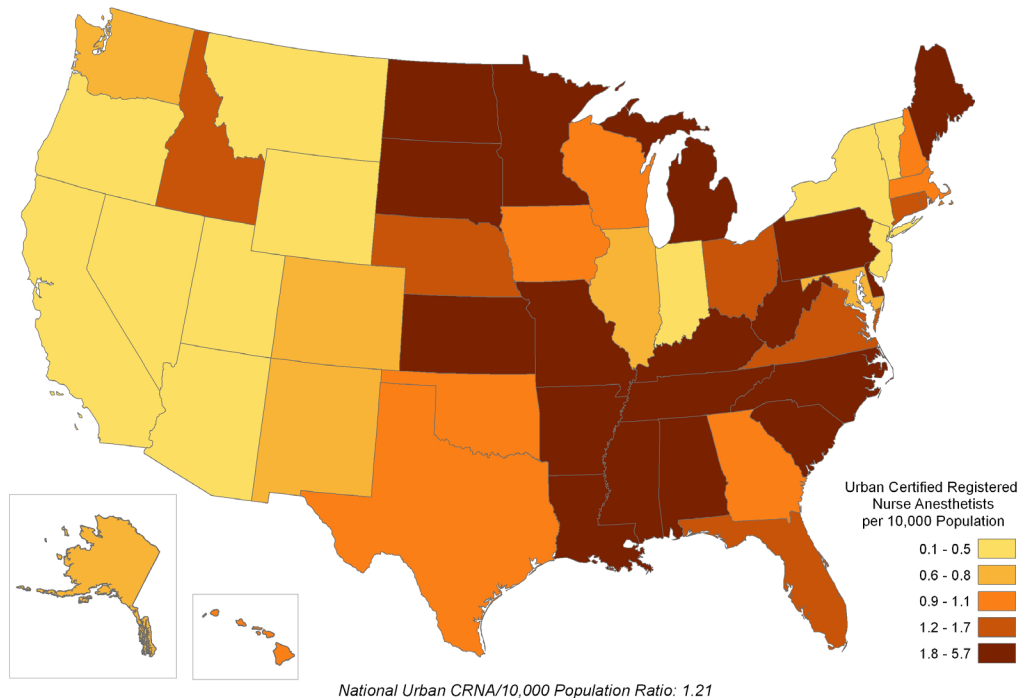
From the 2010 NPI data file, 35,973 CRNAs were identified in the United States after exclusions. The national per capita ratio of all CRNAs to 10,000 population was 1.2. The overall per capita figures at the state level ranged from a low of 0.3/10,000 in Nevada and California to the high of 3.4/10,000 in South Dakota (Appendix A, Table A-3). The state with the fewest CRNAs was Vermont ( $n = 23$ ), and the state with the most was Pennsylvania ( $n = 2,777$ ).

**Urban CRNAs:** Nationally, 30,518 (84.8%) of the 35,973 individual CRNAs indicated they were practicing in urban places (Appendix A, Table A-3). This represented a national urban per capita ratio of 1.2 CRNAs per 10,000 population. At the state level, the lowest urban CRNA ratios were in the West, with the lowest state ratios in Wyoming (0.2/10,000) and Arizona, California, Montana, Nevada, and Vermont (all with 0.3 CRNAs/10,000) (see Figure 4). The highest ratios of urban CRNAs were in the Midwest and the South, with the highest state ratios in South Dakota (5.7/10,000) and North Dakota (4.9/10,000). In 17 states, the per capita number of CRNAs with NPIs

was the same or larger in rural areas compared with urban areas. Among the states, there was considerable variation in the numbers of urban CRNAs. Florida ( $n = 2,659$ ), Pennsylvania ( $n = 2,452$ ), and Texas ( $n = 2,263$ ) had the most urban CRNAs and Wyoming ( $n = 3$ ) and Vermont ( $n = 6$ ) the fewest.

**Rural CRNAs:** Of all CRNAs nationally, 5,455 (15.2%) were in rural locations. The national per capita ratio of rural CRNAs was 0.9 per 10,000 population. Washington, DC, and Rhode Island have no rural areas, as defined by RUCA codes (Appendix A, Table A-4). More states with high CRNA-to-population ratios were found in the Midwest than other regions of the country, and more states in the West and Northeast had low ratios (see Figure 5). At the state level, the highest CRNA ratios were in Kansas and New Hampshire, both with ratios of 1.5/10,000. The states with the lowest rural CRNA ratios were California and Indiana, both with CRNA ratios of 0.3/10,000, and Connecticut, Maryland, New Jersey, and Vermont, all with CRNA ratios of 0.4/10,000. The number of rural CRNAs ranged from lows in New Jersey ( $n = 5$ ) and Hawaii ( $n = 6$ ) to highs in North Carolina ( $n = 399$ ) and Pennsylvania ( $n = 325$ ).

Figure 4: Urban CRNAs per 10,000 State Population, 2010 NPI Data



Map Date: November 2011  
Data Sources: March 2010 National Plan and Provider Enumeration system (NPPES) data file, 2011 Neilson/Claritas Population Estimates

Figure 6 illustrates the variation that exists among per capita ratios of urban CRNAs by state and rural CRNAs by state. The figure is color coded by descending order of state rural per capita ratios.

**CRNAs Within Rural Areas:** Among all rural CRNAs, 66.8% (3,645) practice in large rural areas, 25.8% (1,410) in small rural areas, and 7.3% (400) in isolated small rural areas. The number of CRNAs per 10,000 population declined as degree of rurality increased (1.2, 0.9, and 0.3/10,000 for large, small, and isolated small rural areas, respectively), and likewise, overall, the total number of CRNAs decreased as degree of rurality increased (3,645, 1,410, and 400, respectively). These details and state-level findings can be found in Appendix A, Table A-4.

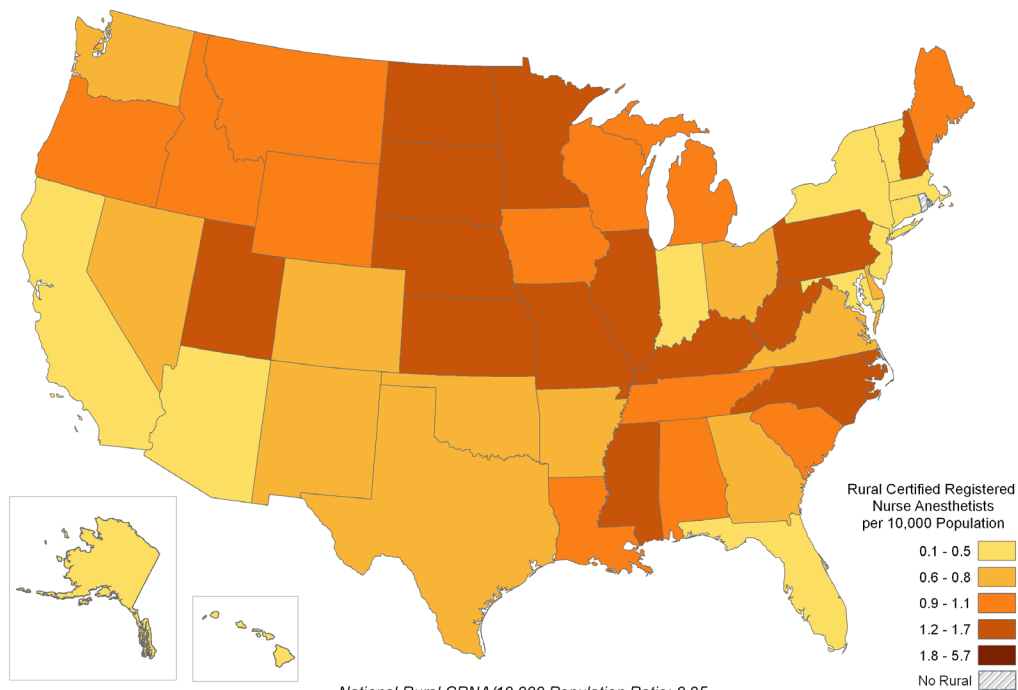
**CRNAs in U.S. Regions:** Regional analyses of the 35,973 CRNAs in this study showed that 5,852 (16.3%) were practicing in the Northeast region, 9,564 (26.6%) in the Midwest, 17,238 (47.9%) in the South, and 3,319 (9.2%) in the West. Regional analyses of the three rural categories consistently showed that as the degree of rurality increased, the percentage of all CRNAs practicing in rural areas decreased.

### Factors Associated with CRNA Rural Practice

The study examined the relationship between state- and individual-level characteristics of CRNAs and the relative risk of CRNA practice in a rural area. These factors included the degree of practice autonomy and number of CRNAs per 10,000 state population and CRNA gender. In the unadjusted and adjusted analyses, CRNAs working in states with the greatest practice autonomy (among three categories) had much greater relative risk of rural practice location compared with CRNAs working in settings where they had less autonomy and where they had no prescriptive authority (Table 4).

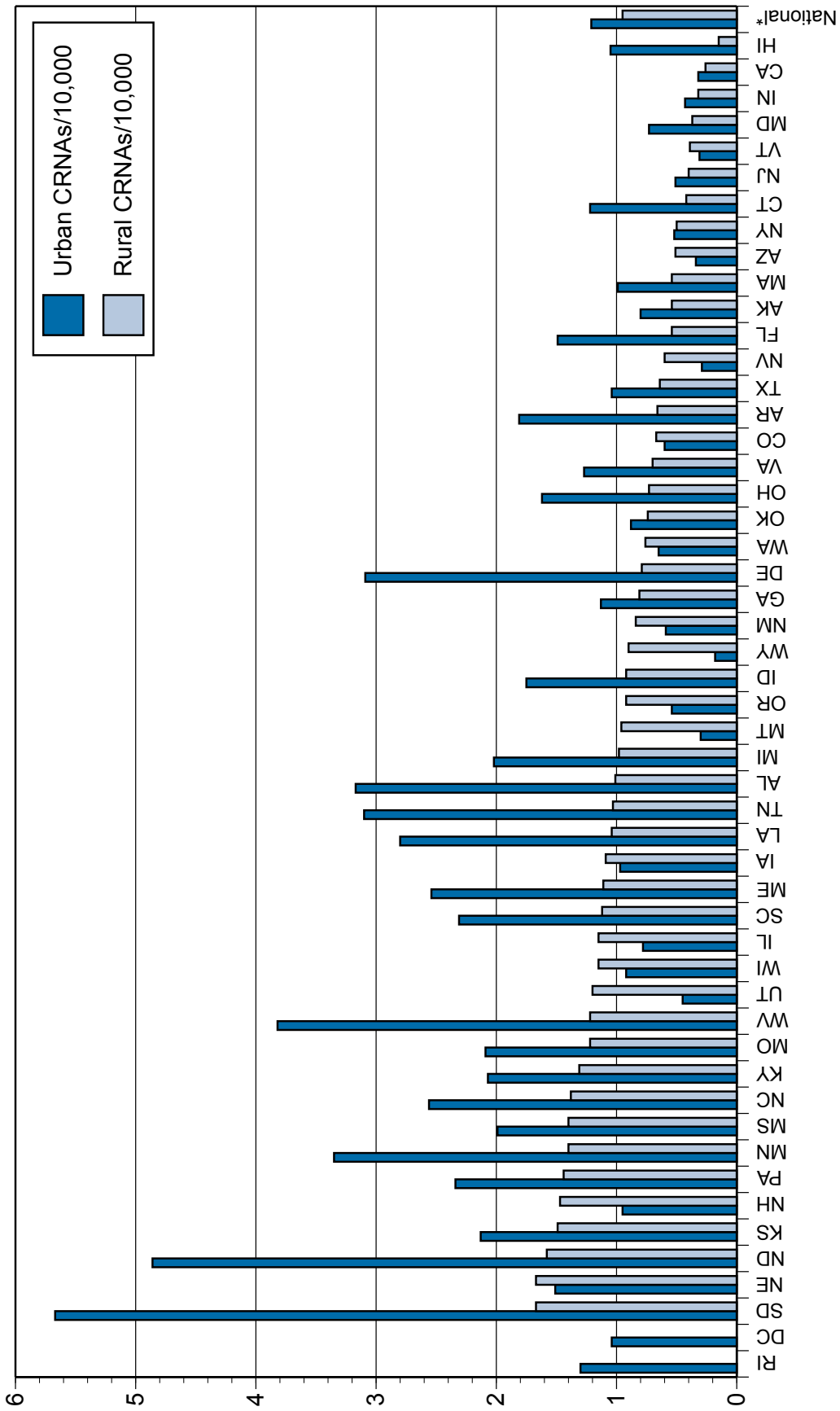
As shown in Table 5, the percentage of male CRNAs was much higher in rural areas (60.9% compared with 38.5% urban). The relative risk of being in a rural location was higher for male CRNAs (RR 1.85,  $P < 0.0001$ ). The overall state CRNA supply (number of CRNAs per 10,000 population) was not significantly associated with greater likelihood of CRNAs practicing in rural areas.

**Figure 5: Rural CRNAs per 10,000 State Population, 2010 NPI Data**



Map Date: November 2011  
 Data Sources: March 2010 National Plan and Provider Enumeration system (NPPES) data file, 2011 Neilson/Claritas Population Estimates

Figure 6: Rural and Urban CRNAs per 10,000 Population by State, 2010 NPI Data



\* Overall national rural CRNAs/10,000: 0.95.

**Table 4. Relative Risk of CRNA Rural Practice Location by Level of Practice Autonomy and Association with Individual and State Characteristics: 2010 NPI Data**

Autonomy Category*	Unadjusted (Rural Practice)		Adjusted for Gender and Per Capita NP Supply	
	Relative Risk (CI)	P Value	Relative Risk (CI)	P Value
Fully autonomous	1.94 (1.34-2.28)	0.0012	2.01 (1.39-2.33)	0.001
Collaboration or supervision	1.24 (0.83-1.79)	0.285	1.21 (0.81-1.75)	0.343

\*Reference category = no prescriptive authority.

**Table 5. Number and Percent of Male CRNAs Overall and in Urban, Rural, and Sub-rural Areas of the United States: 2010 NPI Data**

	Total (n = 35,973)	Urban (n = 30,518)	Rural (n = 5,455)	Sub-rural Areas		
				Large Rural (n = 3,645)	Small Rural (n = 1,410)	Isolated Small Rural (n = 400)
Male CRNAs	15,071	11,748	3,323	2,106	966	251
Percent male	41.9%	38.5%	60.9%	57.8%	68.5%	62.7%

## LIMITATIONS

Some of the limitations of this study relate to the use of secondary data not designed for research or workforce enumeration purposes. Although the NPI was developed to track individual providers through healthcare transactions, the NPI final rule states an individual in a group practice has several options. S/he may obtain an individual NPI and a group NPI, or just a group NPI, or just an individual NPI, depending on how the practice is structured. Either the group NPI or individual NPI may be used on healthcare claims, although some health plans require that pharmacy and laboratory claims include an individual NPI for the prescriber and will reject the group NPI in the prescriber ID field. Some APRNs may not have registered for an individual NPI, resulting in an undercount of the national practicing APRN workforce. As shown by this study's findings, this is particularly true for CNMs and CNSs. Nonetheless, because there are few options for assessing the NP and CRNA workforce, the NPI data set is a resource that merits exploration and appropriate use.

Assuming that the NPI data set undercounts NPs and CRNAs, the number of non-represented providers may be greater among either rural or urban geographic areas and bias the findings from this study's assessment of rural practice. If having an NPI is affected by practice autonomy, then NPs and CRNAs in more

autonomous states may have more individual practices and be more likely to have NPIs, while in states that require supervision or delegation of authority, APRNs may be less likely to have an individual NPI. The organizational use of group NPIs for billing instead of individual NPIs could also impact findings, especially if it occurs more in rural or urban areas, or varies by state. Assessing the extent of these possible biases on this study's results was beyond the scope of this study, but should be examined more closely in future studies.

There is considerable variation in state scope of practice regulations for APRNs. There is no consensus about how to define and group states based on scope of practice. There are several reports issued annually that differ in their characterizations of APRN practice and prescriptive authority among the states by the degree of supervision, delegation, collaboration, or autonomy stipulated by statute or regulation.<sup>16-18</sup> This study's analyses of the relationship between practice autonomy and rural practice relied on categories of autonomy developed for this study, and some of the groupings contain a wide range of scopes of practice, particularly the categories that include collaboration. Further, the degree to which a state implements and requires strict adherence to supervision, delegation, and collaboration varies. In states with fully autonomous practice, employers may impose policies that are stricter than

the law. These factors influence the extent to which an analysis by scope of practice may be limited.

While the most recent version of RUCAs (v. 2.0) available were used to categorize rural and urban geographic areas for this study, they were developed using 2000 census data for work commuting and 2004 ZIP code data, and may not represent population and commuting characteristics that have changed since their development. The alternative would be to use a county-based metropolitan versus non-metropolitan categorization taxonomy. It was decided that the RUCA codes, despite their age, were the preferable alternative. RUCAs allow for much more precise delineation between rural and urban places and also for distinctions to be made among rural areas, which can be an important factor in health workforce supply. County-based taxonomies, on the other hand, often include non-metropolitan areas within metropolitan counties and metropolitan areas within non-metropolitan counties, a situation that muddies the actual geographical character of provider practice location.

## CONCLUSIONS

### NP AND CRNA DISTRIBUTION

These analyses of the 2010 NPI data set show that while the rural penetration of NPs and CRNAs varies by state and type of rural area, NPs and CRNAs are distributed throughout rural areas of the United States.

**NPs:** In almost all states (New Hampshire and New Jersey are exceptions) the number of rural NPs per capita is less than for urban NPs, although the actual number of rural NPs per capita varies considerably among the states. Within rural areas, these analyses of NP distribution showed generally expected trends. The more rural the area (i.e., with smaller and more isolated populations), the lower the number of NPs per capita, although there were many exceptions.

**CRNAs:** While the total number of CRNAs in the United States is considerably smaller than NPs, these analyses of NPI data show that a larger proportion of total CRNAs work in rural areas than NPs. In 17 states, the number of CRNAs per capita was the same or larger in rural areas compared with urban areas. The most populous state in the United States, California, had the lowest number of CRNAs per capita. California is also among the states with the most restrictive practice regulations for CRNAs.

### RURAL PRACTICE

This study showed that CRNAs were more likely to practice in rural areas in states with greater practice autonomy. For NPs, the findings were similar but were of borderline statistical significance. Among states

with statutes or regulations requiring supervision or collaboration arrangements for NPs and CRNAs, there was no clear impact on rural practice. Male NPs and CRNAs were more likely to practice in rural areas, and states with more NPs or CRNAs per capita were more likely to have more of that provider type, per capita, in rural areas.

## IMPLICATIONS FOR POLICY AND PRACTICE

As with many other types of health professionals, larger proportions of NPs and CRNAs practice in urban areas of the United States compared with rural areas. This is not surprising because there are more healthcare jobs per capita in urban areas than in rural ones due to the large number of hospitals and specialty facilities in urban areas, many of which serve as referral facilities for rural populations. But even with some difference expected between rural and urban provider ratios, many rural populations suffer from limited access to primary care, specialist, and oral health providers because of maldistribution of these providers.<sup>19-21</sup> Healthcare provider shortages are likely to worsen in the next two decades because of the combination of several trends: rapid growth in the number of elderly and their higher needs for healthcare; increasing prevalence of chronic conditions; expanded healthcare coverage under the federal Patient Protection and Affordable Care Act; and the rising rates of retirement among the rapidly aging physician, dentist, and nurse workforces. Rural areas of the country will need to continue their work to find the best ways to recruit and retain providers in their communities.

NPs and CRNAs provide important services to rural communities. NPs make up a considerable amount of the workforce in underserved areas.<sup>22</sup> The lower cost of recruiting and employing a CRNA compared with an anesthesiologist can make it feasible for rural areas to retain surgical services in their hospitals. In addition to the lower salary expense, having a CRNA improves the ability of rural communities to recruit and retain general surgeons. Knowledge of the factors related to NP and CRNA rural practice is important to help improve their distribution in rural and other underserved communities.

The results of this study imply that full practice autonomy should be considered as a state-level strategy to encourage rural practice by CRNAs and NPs. Because of complexity and variability among states of APRN scope-of-practice regulations and statutes, more in-depth study is needed to explore how scope of practice and autonomy influence APRN practice location choice. In addition, the ability of NPs and CRNAs to be credentialed and reimbursed by health



plans varies by state and is another factor that requires further study in respect to rural practice.<sup>23</sup>

From these analyses it is clear that encouraging more men to choose careers as NPs or CRNAs would help to increase their numbers in rural communities. The number of men entering the nursing profession has been increasing over the past decades, but still only an estimated 6.6% of RNs in the United States in 2008 (9.6% of those licensed in 2000 or later) were male.<sup>13</sup> In 2008, the number of men among APRNs responding to the National Sample Survey of Registered Nurses was 6.0% of NPs and 41.1% of CRNAs. Clearly, continued efforts are needed to overcome gender disparities in the nursing workforce, but resources expended on this problem would concurrently help resolve some of the APRN maldistribution problems.

The reason why total per capita state NP or CRNA supply might affect the propensity of NPs or CRNAs to practice in rural areas needs further exploration. It could be the result of greater saturation of urban jobs in states with more providers per capita causing more providers to seek rural job opportunities, or it could reflect the overall attractiveness of practice in the state that draws the larger numbers per capita. Similarly, whether APRN education output is greater in states with higher overall per capita numbers should be explored. Mobility of NPs may also be a factor to explore. A recent survey of newly licensed RNs revealed that just over half worked within 40 miles of where they went to high school.<sup>24</sup>

Finally, the numbers of providers and per capita ratios reported here should be compared with other estimates of NP and CRNA supply with caution because the NPI data is likely to underestimate total supply. Similarly, comparisons with physician and physician assistant supply should take into account the likely biases of the NPI data as a basis for estimating workforce size.

## NEXT STEPS AND RECOMMENDATIONS

### ***NPI Data for Workforce Assessment and Research:***

The CMS NPI database is a valuable resource for health workforce planning in the United States, especially for practitioners for which no ongoing national census or survey is available. The NPI data could be made more useful, however, with some key improvements. An ongoing requirement for updating NPI records would reduce or eliminate the current uncertainty as to whether or not a provider in the NPI registry is practicing. While providers have an incentive to update their NPI information to reflect the location where their services occur (and payment should be made), providers who are not actively practicing have no incentive to update their NPI record. Efforts to increase the number of providers with individual NPIs would also enhance the data's

usefulness in enumerating the supply of APRNs and other providers.

***Encouraging Rural NP and CRNA Practice:*** This study made use of a national secondary data set to explore the distribution of NPs and CRNAs in rural and urban areas of the country, and therefore was dependent on the limited amount of data available in the NPI data set to assess factors related to rural practice. Additional research to collect more detailed information about rural NP and CRNA providers and the characteristics of the states in which they practice would improve understanding of other factors that influence the decision about whether to practice in rural areas.

## REFERENCES

1. Goolsby MJ. 2009-2010 AANP national nurse practitioner sample survey: an overview. *J Am Acad Nurse Pract.* May 2011;23(5):266-268.
2. Kaplan L, Brown MA, Andrilla CH, Hart LG. Rural-urban practice patterns of nurse practitioners in Washington State. *J Nurse Pract.* 2009;5(3):169-175.
3. Centers for Medicare & Medicaid Services. National Plan and Provider Enumeration System (NPPES). Available at: <https://nppes.cms.hhs.gov/NPPES/Welcome.do>. Accessed January 19, 2012.
4. McMenamin P. *ANA Issue Brief: APRNs with NPIs: Distribution by Role and State*. Silver Spring, MD: American Nurses Association; 2010.
5. Washington Publishing Company. Code lists and X12 registry. Available at: <http://www.wpc-edi.com/reference/>. Accessed January 19, 2012.
6. Kaplan L, Brown MA, Simonson D. CRNA prescribing practices: the Washington State experience. *AANA J.* Feb 2011;79(1):24-29.
7. Morrill R, Cromartie J, Hart LG. Metropolitan, urban, and rural commuting areas: toward a better depiction of the US settlement system. *Urban Geography.* 1999;20(8):727-748.
8. Chan L, Giardino N, Rubenfeld G, Baldwin LM, Fordyce MA, Hart LG. Geographic differences in use of home oxygen for obstructive lung disease: a national Medicare study. *J Rural Health.* Summer 2010;26(2):139-145.
9. Chen F, Fordyce M, Andes S, Hart LG. Which medical schools produce rural physicians? A 15-year update. *Acad Med.* Apr 2010;85(4):594-598.

10. Hillemeier MM, Weisman CS, Chase GA, Dyer AM. Individual and community predictors of preterm birth and low birthweight along the rural-urban continuum in central Pennsylvania. *J Rural Health*. Winter 2007;23(1):42-48.
11. Neilson/Claritas. *2011 Selected Population Facts Data for All ZIP Codes Nationwide*. Custom-prepared data CD. San Diego, CA: Neilson/Claritas; 2011.
12. Zhang J, Yu KF. What's the relative risk? A method of correcting the odds ratio in cohort studies of common outcomes. *JAMA*. Nov 18 1998;280(19):1690-1691.
13. Health Resources and Services Administration. *The Registered Nurse Population: Findings from the 2008 National Sample Survey of Registered Nurses*. Washington, DC: U.S. Department of Health and Human Services; 2010.
14. American Academy of Nurse Practitioners. *Frequently Asked Questions: Why Choose a Nurse Practitioner as Your Healthcare Provider?* Austin, TX: American Academy of Nurse Practitioners; 2010.
15. American Academy of Nurse Practitioners. *2009-10 AANP National NP Sample Survey: An Overview*. Austin, TX: American Academy of Nurse Practitioners; 2010.
16. Pearson LJ. The Pearson report: the national overview of nurse practitioner legislation and healthcare issues. Available at: <http://www.pearsonreport.com/>. Accessed January 20, 2012.
17. Phillips SJ. 23rd annual legislative update. *Nurse Pract*. 2011;36(1):30-52.
18. Byrne W. U.S. nurse practitioner prescribing law: a state-by-state summary. Available at: <http://www.medscape.com/viewarticle/440315>. Accessed February 2, 2012.
19. Doescher MP, Keppel GA, Skillman SM, Rosenblatt RA. *Policy Brief: The Crisis in Rural Dentistry*. Seattle, WA: WWAMI Rural Health Research Center, University of Washington; 2009.
20. Doescher MP, Skillman SM, Rosenblatt RA. *Policy Brief: The Crisis in Rural Primary Care*. Seattle, WA: WWAMI Rural Health Research Center, University of Washington; 2009.
21. Skillman SM, Doescher MP, Rosenblatt RA. *Policy Brief: Threats to the Future Supply of Rural Registered Nurses*. Seattle, WA: WWAMI Rural Health Research Center, University of Washington; 2009.
22. Grumbach K, Hart LG, Mertz E, Coffman J, Palazzo L. Who is caring for the underserved? A comparison of primary care physicians and nonphysician clinicians in California and Washington. *Ann Fam Med*. Jul-Aug 2003;1(2):97-104.
23. Hansen-Turton T, Ritter A, Torgan R. Insurers' contracting policies on nurse practitioners as primary care providers: two years later. *Policy Polit Nurs Pract*. Nov 2008;9(4):241-248.
24. Kovner CT, Corcoran SP, Brewer CS. The relative geographic immobility of new registered nurses calls for new strategies to augment that workforce. *Health Aff (Millwood)*. Dec 2011;30(12):2293-2300.

**APPENDIX A**

Table A-1: Per Capita Supply and Number of Nurse Practitioners by State, 2010 NPI Data.....	20
Table A-2: Rural Per Capita Supply and Number of Nurse Practitioners by State, 2010 NPI Data.....	22
Table A-3: Per Capita Supply and Number of Certified Registered Nurse Anesthetists by State, 2010 NPI Data.....	24
Table A-4: Rural Per Capita Supply and Number of Certified Registered Nurse Anesthetists by State, 2010 NPI Data .....	26

**Table A-1: Per Capita Supply and Number of Nurse Practitioners by State, 2010 NPI Data**

State	Total		Urban			Rural		
	NPs/10,000 Population	Total Number of NPs	NPs/10,000 Population	Total Number of NPs	% of All NPs	NPs/10,000 Population	Total Number of NPs	% of All NPs
<b>Northeast</b>								
Connecticut	5.0	1,779	5.0	1,716	96.5	3.8	63	3.5
Maine	6.3	837	8.0	533	63.7	4.6	304	36.3
Massachusetts	6.6	4,355	6.7	4,300	98.7	3.3	55	1.3
New Hampshire	6.2	818	5.3	433	52.9	7.7	385	47.1
New Jersey	2.6	2,284	2.6	2,249	98.5	2.8	35	1.5
New York	4.5	8,779	4.6	7,986	91.0	4.2	793	9.0
Pennsylvania	3.4	4,338	3.7	3,850	88.8	2.2	488	11.2
Rhode Island	4.0	425	4.0	425	100.0	N/A	N/A	N/A
Vermont	4.7	297	6.2	120	40.4	4.1	177	59.6
<b>Midwest</b>								
Illinois	2.2	2,799	2.2	2,415	86.3	2.2	384	13.7
Indiana	3.6	2,324	4.0	1,938	83.4	2.4	386	16.6
Iowa	3.3	1,004	4.0	677	67.4	2.4	327	32.6
Kansas	4.1	1,181	4.4	739	62.6	3.8	442	37.4
Michigan	2.7	2,675	2.8	2,222	83.1	2.4	453	16.9
Minnesota	6.0	3,199	7.5	2,827	88.4	2.4	372	11.6
Missouri	4.3	2,570	4.5	1,922	74.8	3.7	648	25.2
Nebraska	4.0	728	5.0	530	72.8	2.5	198	27.2
North Dakota	5.1	342	6.6	212	62.0	3.7	130	38.0
Ohio	3.1	3,570	3.4	3,139	87.9	1.8	431	12.1
South Dakota	3.9	320	5.9	209	65.3	2.4	111	34.7
Wisconsin	3.9	2,240	4.4	1,750	78.1	2.8	490	21.9
<b>South</b>								
Alabama	2.8	1,337	3.1	1,035	77.4	2.1	302	22.6
Arkansas	3.1	918	3.8	612	66.7	2.3	306	33.3
D.C.	8.7	523	8.7	523	100.0	N/A	N/A	N/A
Delaware	4.9	448	5.5	387	86.4	3.0	61	13.6
Florida	3.5	6,602	3.5	6,262	94.9	3.0	340	5.1
Georgia	2.9	2,875	3.0	2,372	82.5	2.6	503	17.5
Kentucky	4.6	2,018	5.4	1,210	60.0	3.8	808	40.0
Louisiana	3.2	1,458	3.4	1,166	80.0	2.5	292	20.0
Maryland	3.8	2,184	3.8	2,046	93.7	3.2	138	6.3
Mississippi	5.1	1,508	5.7	696	46.2	4.6	812	53.8
North Carolina	3.3	3,146	3.6	2,407	76.5	2.6	739	23.5
Oklahoma	1.9	722	2.0	446	61.8	1.8	276	38.2
South Carolina	3.0	1,408	3.3	1,125	79.9	2.3	283	20.1
Tennessee	6.2	3,947	7.0	3,155	79.9	4.2	792	20.1
Texas	2.4	6,105	2.5	5,482	89.8	1.7	623	10.2
Virginia	3.4	2,737	3.5	2,378	86.9	2.7	359	13.1
West Virginia	3.2	586	3.7	337	57.5	2.6	249	42.5

State	Total		Urban			Rural		
	NPs/10,000 Population	Total Number of NPs	NPs/10,000 Population	Total Number of NPs	% of All NPs	NPs/10,000 Population	Total Number of NPs	% of All NPs
West								
Alaska	6.2	441	6.6	315	71.4	5.2	126	28.6
Arizona	3.4	2,242	3.5	1,985	88.5	2.7	257	11.5
California	2.3	8,458	2.3	7,899	93.4	2.2	559	6.6
Colorado	3.6	1,848	3.8	1,658	89.7	2.6	190	10.3
Hawaii	2.4	322	2.6	244	75.8	1.9	78	24.2
Idaho	2.9	466	3.5	359	77.0	1.9	107	23.0
Montana	3.9	389	4.1	147	37.8	3.8	242	62.2
Nevada	1.7	455	1.7	422	92.7	1.2	33	7.3
New Mexico	3.3	681	3.3	450	66.1	3.2	231	33.9
Oregon	4.1	1,580	4.3	1,240	78.5	3.4	340	21.5
Utah	3.3	929	3.6	878	94.5	1.5	51	5.5
Washington	4.0	2,726	4.1	2,429	89.1	3.3	297	10.9
Wyoming	3.3	190	5.3	90	47.4	2.5	100	52.6
National	3.4	106,113	3.6	89,947	84.8	2.8	16,166	15.2

**Table A-2: Rural Per Capita Supply and Number of Nurse Practitioners by State, 2010 NPI Data**

State	Total Rural		Large Rural			Small Rural			Isolated Small Rural		
	NPs/ 10,000 Pop.	Total Number of NPs	NPs/ 10,000 Pop.	Total Number of NPs	% of All Rural NPs	NPs/ 10,000 Pop.	Total Number of NPs	% of All Rural NPs	NPs/ 10,000 Pop.	Total Number of NPs	% of All Rural NPs
<b>Northeast</b>											
Connecticut	3.8	63	4.6	59	93.7	0.0	0	0.0	1.5	4	6.3
Maine	4.6	304	5.2	127	41.8	5.8	83	27.3	3.4	94	30.9
Massachusetts	3.3	55	3.0	30	54.5	4.5	22	40.0	1.5	3	5.5
New Hampshire	7.7	385	10.0	287	74.5	5.0	41	10.6	4.3	57	14.8
New Jersey	2.8	35	2.8	35	100.0	N/A	N/A	N/A	N/A	N/A	N/A
New York	4.2	793	4.9	483	60.9	4.2	192	24.2	2.6	118	14.9
Pennsylvania	2.2	488	2.5	362	74.2	2.3	80	16.4	1.1	46	9.4
Rhode Island	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vermont	4.1	177	5.4	67	37.9	4.7	60	33.9	2.8	50	28.2
<b>Midwest</b>											
Illinois	2.2	384	2.7	217	56.5	2.0	133	34.6	1.4	34	8.9
Indiana	2.4	386	2.9	267	69.2	1.7	81	21.0	1.7	38	9.8
Iowa	2.4	327	3.1	127	38.8	2.5	126	38.5	1.7	74	22.6
Kansas	3.8	442	4.1	277	62.7	3.7	82	18.6	3.0	83	18.8
Michigan	2.4	453	2.8	244	53.9	2.2	133	29.4	2.0	76	16.8
Minnesota	2.4	372	2.9	198	53.2	2.1	82	22.0	1.9	92	24.7
Missouri	3.7	648	4.8	357	55.1	3.1	157	24.2	2.6	134	20.7
Nebraska	2.5	198	3.6	129	65.2	1.5	27	13.6	1.7	42	21.2
North Dakota	3.7	130	3.5	42	32.3	4.6	22	16.9	3.7	66	50.8
Ohio	1.8	431	2.1	347	80.5	1.4	73	16.9	0.5	11	2.6
South Dakota	2.4	111	2.6	51	45.9	2.9	20	18.0	2.0	40	36.0
Wisconsin	2.8	490	3.3	196	40.0	3.2	178	36.3	2.0	116	23.7
<b>South</b>											
Alabama	2.1	302	2.6	146	48.3	1.9	94	31.1	1.7	62	20.5
Arkansas	2.3	306	2.6	169	55.2	2.0	88	28.8	2.1	49	16.0
D.C.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Delaware	3.0	61	3.0	43	70.5	3.9	17	27.9	0.6	1	1.6
Florida	3.0	340	3.1	192	56.5	3.2	115	33.8	2.0	33	9.7
Georgia	2.6	503	3.2	306	60.8	1.9	125	24.9	2.2	72	14.3
Kentucky	3.8	808	4.6	410	50.7	3.6	246	30.4	2.8	152	18.8
Louisiana	2.5	292	2.9	194	66.4	2.0	73	25.0	2.0	25	8.6
Maryland	3.2	138	3.5	99	71.7	3.4	34	24.6	1.1	5	3.6
Mississippi	4.6	812	5.9	523	64.4	3.4	187	23.0	3.3	102	12.6
North Carolina	2.6	739	2.7	482	65.2	2.4	141	19.1	2.3	116	15.7
Oklahoma	1.8	276	2.2	158	57.2	1.9	85	30.8	1.1	33	12.0
South Carolina	2.3	283	2.5	213	75.3	2.2	54	19.1	1.1	16	5.7
Tennessee	4.2	792	4.5	437	55.2	4.0	246	31.1	3.6	109	13.8
Texas	1.7	623	1.8	365	58.6	1.6	157	25.2	1.3	101	16.2
Virginia	2.7	359	2.7	75	20.9	2.7	150	41.8	2.6	134	37.3
West Virginia	2.6	249	2.8	112	45.0	3.3	79	31.7	1.9	58	23.3

State	Total Rural		Large Rural			Small Rural			Isolated Small Rural		
	NPs/ 10,000 Pop.	Total Number of NPs	NPs/ 10,000 Pop.	Total Number of NPs	% of All Rural NPs	NPs/ 10,000 Pop.	Total Number of NPs	% of All Rural NPs	NPs/ 10,000 Pop.	Total Number of NPs	% of All Rural NPs
West											
Alaska	5.2	126	4.4	27	21.4	6.8	55	43.7	4.4	44	34.9
Arizona	2.7	257	3.0	136	52.9	2.5	99	38.5	2.3	22	8.6
California	2.2	559	2.2	375	67.1	2.1	115	20.6	2.5	69	12.3
Colorado	2.6	190	2.8	64	33.7	2.6	82	43.2	2.3	44	23.2
Hawaii	1.9	78	2.0	65	83.3	2.0	10	12.8	1.0	3	3.8
Idaho	1.9	107	1.8	41	38.3	2.5	44	41.1	1.5	22	20.6
Montana	3.8	242	4.3	113	46.7	5.2	91	37.6	1.9	38	15.7
Nevada	1.2	33	1.3	19	57.6	1.2	10	30.3	1.0	4	12.1
New Mexico	3.2	231	2.9	148	64.1	3.4	36	15.6	4.4	47	20.3
Oregon	3.4	340	3.8	246	72.4	2.9	58	17.1	2.5	36	10.6
Utah	1.5	51	1.5	18	35.3	1.8	24	47.1	1.0	9	17.6
Washington	3.3	297	3.3	159	53.5	3.5	82	27.6	3.0	56	18.9
Wyoming	2.5	100	3.0	64	64.0	1.9	21	21.0	2.0	15	15.0
National	2.8	16,166	3.1	9,301	57.5	2.6	4,210	26.0	2.2	2,655	16.4

**Table A-3: Per Capita Supply and Number of Certified Registered Nurse Anesthetists by State, 2010 NPI Data**

State	Total		Urban			Rural		
	CRNAs/ 10,000 Population	Total Number of CRNAs	CRNAs/ 10,000 Population	Total Number of CRNAs	% of All CRNAs	CRNAs/ 10,000 Population	Total Number of CRNAs	% of All CRNAs
<b>Northeast</b>								
Connecticut	1.2	424	1.2	417	98.3	0.4	7	1.7
Maine	1.8	243	2.5	169	69.5	1.1	74	30.5
Massachusetts	1.0	639	1.0	630	98.6	0.5	9	1.4
New Hampshire	1.1	152	1.0	78	51.3	1.5	74	48.7
New Jersey	0.5	448	0.5	443	98.9	0.4	5	1.1
New York	0.5	1,009	0.5	914	90.6	0.5	95	9.4
Pennsylvania	2.2	2,777	2.3	2,452	88.3	1.4	325	11.7
Rhode Island	1.3	137	1.3	137	100.0	N/A	N/A	N/A
Vermont	0.4	23	0.3	6	26.1	0.4	17	73.9
<b>Midwest</b>								
Illinois	0.8	1,063	0.8	866	81.5	1.2	197	18.5
Indiana	0.4	263	0.4	211	80.2	0.3	52	19.8
Iowa	1.0	313	1.0	164	52.4	1.1	149	47.6
Kansas	1.9	535	2.1	360	67.3	1.5	175	32.7
Michigan	1.8	1,802	2.0	1,620	89.9	1.0	182	10.1
Minnesota	2.8	1,487	3.4	1,271	85.5	1.4	216	14.5
Missouri	1.8	1,104	2.1	889	80.5	1.2	215	19.5
Nebraska	1.6	289	1.5	159	55.0	1.7	130	45.0
North Dakota	3.2	212	4.9	157	74.1	1.6	55	25.9
Ohio	1.4	1,654	1.6	1,475	89.2	0.7	179	10.8
South Dakota	3.4	279	5.7	202	72.4	1.7	77	27.6
Wisconsin	1.0	563	0.9	363	64.5	1.1	200	35.5
<b>South</b>								
Alabama	2.5	1,217	3.2	1,075	88.3	1.0	142	11.7
Arkansas	1.3	379	1.8	293	77.3	0.7	86	22.7
D.C.	1.0	63	1.0	63	100.0	N/A	N/A	N/A
Delaware	2.6	233	3.1	217	93.1	0.8	16	6.9
Florida	1.4	2,721	1.5	2,659	97.7	0.5	62	2.3
Georgia	1.1	1,043	1.1	886	84.9	0.8	157	15.1
Kentucky	1.7	741	2.1	463	62.5	1.3	278	37.5
Louisiana	2.3	1,066	2.8	947	88.8	1.0	119	11.2
Maryland	0.7	409	0.7	393	96.1	0.4	16	3.9
Mississippi	1.6	488	2.0	243	49.8	1.4	245	50.2
North Carolina	2.2	2,130	2.6	1,731	81.3	1.4	399	18.7
Oklahoma	0.8	311	0.9	201	64.6	0.7	110	35.4
South Carolina	2.0	930	2.3	789	84.8	1.1	141	15.2
Tennessee	2.5	1,591	3.1	1,397	87.8	1.0	194	12.2
Texas	1.0	2,503	1.0	2,263	90.4	0.6	240	9.6
Virginia	1.2	950	1.3	856	90.1	0.7	94	9.9
West Virginia	2.5	463	3.8	348	75.2	1.2	115	24.8



State	Total		Urban			Rural		
	CRNAs/ 10,000 Population	Total Number of CRNAs	CRNAs/ 10,000 Population	Total Number of CRNAs	% of All CRNAs	CRNAs/ 10,000 Population	Total Number of CRNAs	% of All CRNAs
West								
Alaska	0.7	51	0.8	38	74.5	0.5	13	25.5
Arizona	0.4	239	0.3	191	79.9	0.5	48	20.1
California	0.3	1,200	0.3	1,135	94.6	0.3	65	5.4
Colorado	0.6	308	0.6	258	83.8	0.7	50	16.2
Hawaii	0.8	106	1.1	100	94.3	0.1	6	5.7
Idaho	1.5	231	1.7	180	77.9	0.9	51	22.1
Montana	0.7	72	0.3	11	15.3	1.0	61	84.7
Nevada	0.3	87	0.3	71	81.6	0.6	16	18.4
New Mexico	0.7	141	0.6	80	56.7	0.8	61	43.3
Oregon	0.6	246	0.5	155	63.0	0.9	91	37.0
Utah	0.5	151	0.4	110	72.8	1.2	41	27.2
Washington	0.7	448	0.6	379	84.6	0.8	69	15.4
Wyoming	0.7	39	0.2	3	7.7	0.9	36	92.3
National	1.2	35,973	1.2	30,518	84.8	0.9	5,455	15.2

**Table A-4: Rural Per Capita Supply and Number of Certified Registered Nurse Anesthetists by State, 2010 NPI Data**

State	Total Rural		Large Rural			Small Rural			Isolated Small Rural		
	CRNAs/ 10,000 Pop.	Total Number of CRNAs	CRNAs/ 10,000 Pop.	Total Number of CRNAs	% of All Rural CRNAs	CRNAs/ 10,000 Pop.	Total Number of CRNAs	% of All Rural CRNAs	CRNAs/ 10,000 Pop.	Total Number of CRNAs	% of all Rural CRNAs
<b>Northeast</b>											
Connecticut	0.4	7	0.5	7	100.0	0.0	0	0.0	0.0	0	0.0
Maine	1.1	74	0.8	20	27.0	1.7	24	32.4	1.1	30	40.5
Massachusetts	0.5	9	0.7	7	77.8	0.4	2	22.2	0.0	0	0.0
New Hampshire	1.5	74	2.0	56	75.7	0.8	7	9.5	0.8	11	14.9
New Jersey	0.4	5	0.4	5	100.0	N/A	N/A	N/A	N/A	N/A	N/A
New York	0.5	95	0.5	52	54.7	0.5	22	23.2	0.5	21	22.1
Pennsylvania	1.4	325	1.8	273	84.0	1.2	41	12.6	0.3	11	3.4
Rhode Island	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Vermont	0.4	17	0.2	3	17.6	0.9	12	70.6	0.1	2	11.8
<b>Midwest</b>											
Illinois	1.2	197	1.8	142	72.1	0.8	54	27.4	0.0	1	0.5
Indiana	0.3	52	0.4	34	65.4	0.4	18	34.6	0.0	0	0.0
Iowa	1.1	149	1.5	60	40.3	1.5	74	49.7	0.3	15	10.1
Kansas	1.5	175	1.9	127	72.6	1.5	34	19.4	0.5	14	8.0
Michigan	1.0	182	1.2	108	59.3	1.1	65	35.7	0.2	9	4.9
Minnesota	1.4	216	1.9	129	59.7	1.8	69	31.9	0.4	18	8.3
Missouri	1.2	215	2.1	158	73.5	0.7	37	17.2	0.4	20	9.3
Nebraska	1.7	130	2.3	83	63.8	2.2	39	30.0	0.3	8	6.2
North Dakota	1.6	55	3.6	43	78.2	1.5	7	12.7	0.3	5	9.1
Ohio	0.7	179	0.9	156	87.2	0.4	21	11.7	0.1	2	1.1
South Dakota	1.7	77	2.9	57	74.0	1.2	8	10.4	0.6	12	15.6
Wisconsin	1.1	200	1.3	81	40.5	1.6	92	46.0	0.5	27	13.5
<b>South</b>											
Alabama	1.0	142	1.6	93	65.5	0.7	35	24.6	0.4	14	9.9
Arkansas	0.7	86	0.9	56	65.1	0.6	26	30.2	0.2	4	4.7
D.C.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Delaware	0.8	16	1.1	16	100.0	0.0	0	0.0	0.0	0	0.0
Florida	0.5	62	0.5	32	51.6	0.6	21	33.9	0.5	9	14.5
Georgia	0.8	157	1.1	107	68.2	0.6	38	24.2	0.4	12	7.6
Kentucky	1.3	278	1.9	166	59.7	1.3	87	31.3	0.5	25	9.0
Louisiana	1.0	119	1.4	93	78.2	0.7	26	21.8	0.0	0	0.0
Maryland	0.4	16	0.3	10	62.5	0.6	6	37.5	0.0	0	0.0
Mississippi	1.4	245	2.4	216	88.2	0.4	24	9.8	0.2	5	2.0
North Carolina	1.4	399	1.8	329	82.5	0.9	51	12.8	0.4	19	4.8
Oklahoma	0.7	110	1.1	78	70.9	0.5	23	20.9	0.3	9	8.2
South Carolina	1.1	141	1.5	128	90.8	0.4	10	7.1	0.2	3	2.1
Tennessee	1.0	194	1.4	140	72.2	0.8	47	24.2	0.2	7	3.6
Texas	0.6	240	0.8	151	62.9	0.8	73	30.4	0.2	16	6.7
Virginia	0.7	94	0.6	17	18.1	1.1	62	66.0	0.3	15	16.0
West Virginia	1.2	115	1.8	70	60.9	1.5	36	31.3	0.3	9	7.8

State	Total Rural		Large Rural			Small Rural			Isolated Small Rural		
	CRNAs/ 10,000 Pop.	Total Number of CRNAs	CRNAs/ 10,000 Pop.	Total Number of CRNAs	% of All Rural CRNAs	CRNAs/ 10,000 Pop.	Total Number of CRNAs	% of All Rural CRNAs	CRNAs/ 10,000 Pop.	Total Number of CRNAs	% of all Rural CRNAs
West											
Alaska	0.5	13	0.8	5	38.5	0.7	6	46.2	0.2	2	15.4
Arizona	0.5	48	0.6	26	54.2	0.5	21	43.8	0.1	1	2.1
California	0.3	65	0.3	46	70.8	0.2	13	20.0	0.2	6	9.2
Colorado	0.7	50	0.8	18	36.0	0.8	27	54.0	0.3	5	10.0
Hawaii	0.1	6	0.2	5	83.3	0.2	1	16.7	0.0	0	0.0
Idaho	0.9	51	1.0	23	45.1	1.3	23	45.1	0.3	5	9.8
Montana	1.0	61	0.8	22	36.1	1.7	30	49.2	0.5	9	14.8
Nevada	0.6	16	0.8	11	68.8	0.6	5	31.3	0.0	0	0.0
New Mexico	0.8	61	1.0	51	83.6	0.9	10	16.4	0.0	0	0.0
Oregon	0.9	91	1.0	63	69.2	1.3	25	27.5	0.2	3	3.3
Utah	1.2	41	1.5	18	43.9	1.5	20	48.8	0.3	3	7.3
Washington	0.8	69	0.7	36	52.2	1.0	24	34.8	0.5	9	13.0
Wyoming	0.9	36	0.8	18	50.0	1.3	14	38.9	0.5	4	11.1
National	0.9	5,455	1.2	3,645	66.8	0.9	1,410	25.8	0.3	400	7.3

# RELATED RESOURCES FROM THE WWAMI RURAL HEALTH RESEARCH CENTER AND THE CENTER FOR HEALTH WORKFORCE STUDIES

## ARTICLES

Skillman SM, Doescher MP, Mouradian WE, Brunson DK. The challenge to delivering oral health services in rural America. *J Public Health Dent.* Jun 2010;70(S1):S49-S57.

Skillman SM, Palazzo L, Hart LG, Keepnews D. The characteristics of registered nurses whose licenses expire: why they leave nursing and implications for retention and re-entry. *Nurs Econ.* May-Jun 2010;28(3):181-189.

Chen F, Fordyce M, Andes S, Hart LG. Which medical schools produce rural physicians? A 15-year update. *Acad Med.* Apr 2010;85(4):594-598.

Skillman SM, Andrilla CHA, Patterson DG, Tieman L, Doescher MP. The licensed practical nurse workforce in the United States: one state's experience. *Cah Sociol Demogr Med.* Apr-Jun 2010;50(2):179-212.

Thompson MJ, Hagopian A, Fordyce M, Hart LG. Do international medical graduates (IMGs) "fill the gap" in rural primary care in the United States? A national study. *J Rural Health.* Spring 2009;25(2):124-134.

Lynge DC, Larson EH, Thompson MJ, Rosenblatt RA, Hart LG. A longitudinal analysis of the general surgery workforce in the United States, 1981-2005. *Arch Surg.* Apr 2008;143(4):345-350.

Hart LG, Skillman SM, Fordyce MA, Thompson MJ, Hagopian A, Konrad TR. International medical graduate physicians in the United States: changes since 1981. *Health Aff.* 2007;26(4):1159-116

Benedetti TJ, Baldwin LM, Skillman SM, Andrilla CHA, Bowditch E, Carr KC, Myers SJ. Professional liability issues and practice patterns of obstetrical providers in Washington State. *Obstet Gynecol.* Jun 2006;107(6):1238-1246.

## REPORTS

Skillman SM, Andrilla CHA, Tieman L, McCook AU. *Washington State registered nurse supply and demand projections: 2011-2031.* Final Report #134. Seattle, WA: WWAMI Center for Health Workforce Studies; Dec 2011.

Rosenblatt RA, Chen FM, Lishner DM, Doescher MP. *The future of family medicine and implications for rural primary care physician supply.* Final Report #125. Seattle, WA: WWAMI Rural Health Research Center, University of Washington; Aug 2010.

## POLICY BRIEFS

Doescher MP, Fordyce MA, Skillman SM. *Policy brief: the aging of the primary care physician workforce: are rural locations vulnerable?* Seattle, WA: WWAMI Rural Health Research Center, University of Washington; Jun 2009.

Doescher MP, Keppel G, Skillman SM. *Policy brief: the crisis in rural dentistry.* Seattle, WA: WWAMI Rural Health Research Center, University of Washington; Apr 2009

Doescher MP, Lynge D, Skillman SM. *Policy brief: the crisis in rural general surgery.* Seattle, WA: WWAMI Rural Health Research Center, University of Washington; Apr 2009.

Doescher MP, Skillman SM, Rosenblatt RA. *Policy brief: the crisis in rural primary care.* Seattle, WA: WWAMI Rural Health Research Center, University of Washington; Apr 2009

Skillman SM, Doescher MP, Rosenblatt RA. *Policy brief: threats to the future supply of rural registered nurses.* Seattle, WA: WWAMI Rural Health Research Center, University of Washington; Apr 2009.

For a complete list of publications by the Rural Health Research Center, visit <http://depts.washington.edu/uwrhrc/>.