

---

# Practice Patterns

---

## Variations in Nurse Practitioner Use in Veterans Affairs Primary Care Practices

*Patty Y. Huang, Elizabeth M. Yano, Martin L. Lee, Betty L. Chang, and Lisa V. Rubenstein*

---

**Background.** Increasingly, primary care practices include nurse practitioners (NPs) in their staffing mix to contain costs and expand primary care. To achieve these aims in U.S. Department of Veterans Affairs medical centers (VAMCs), national policy endorsed involvement of NPs as primary care (PC) providers.

**Objectives.** To evaluate the degree to which VAMCs incorporated NPs into PC practices between 1996 and 1999, and to identify the internal and external practice environment features associated with NP use.

**Study Design.** We surveyed 131 PC directors of all VAMCs in 1996 and 1999 to ascertain the staffing and characteristics of the PC practice and parent organization (e.g., academic affiliation, level of physician staffing, use of managed care arrangements), and drew on previously published studies and HRSA State Health Workforce Profiles to characterize each practice's regional health care environment (e.g., geographic region, state NP practice laws, state managed care penetration). Using multivariate linear regression, we evaluate the contribution of these environmental and organizational factors on the number of NPs/10,000 PC patients in 1999, controlling for the rate of NP use in 1996.

**Principal Findings.** From 1996–1999, NP use increased from 75 percent to 90 percent in VA PC practices. The mean number of NPs per practice increased by about 60 percent (2.0 versus 3.2;  $p < .001$ ), while the rate of NPs/10,000 PC patients trended upward (2.2 versus 2.7;  $p = .09$ ). Staffing of other primary care clinicians (e.g., physicians and physician assistants per practice) remained stable, while the NP-per-physician rate increased (0.2 versus 0.4;  $p < .001$ ). After multivariate adjustment, greater reliance on managed-care-oriented provider education programs ( $p = .02$ ), the presence of NP training programs ( $p = .05$ ), and more specialty-trained physicians/10,000 PC patients ( $p = .09$ ) were associated with greater NP involvement in primary care.

**Conclusions.** Staffing models in VA PC practices have, in fact, changed, with NPs having a greater presence. However, we found substantial practice-based variations in their use, suggesting that more research is needed to better understand how they have been integrated into practice and what impact their involvement has had on the VA's ability to achieve its restructuring goals.

**Key Words.** Nurse practitioner, primary care staffing, practice characteristics, environmental characteristics

---

Health care organizations face ongoing pressures to deliver high-quality care, ensure access to care, and contain costs. Increasingly, primary care practices include nurse practitioners (NPs) in their staffing mix in order to meet these demands (Dial et al. 1995; Scheffler 1996; Hooker and Berlin 2002). This trend has been supported by research showing that NPs can deliver general medical care comparable in quality to physicians' care (Lewis and Resnik 1967; Spitzer et al. 1974; Brown and Grimes 1995; Office of Technology Assessment, U.S. Congress 1986; Horrocks, Anderson, and Salisbury 2002). In addition, NPs can be employed at salaries less than physicians (Rogers, Sweeting, and Davis 1989; Lowes 1998), and prior research suggests that physician-NP teams are more productive than physicians working alone (Reinhardt 1975; Safriet 1992; Record et al. 1980). By 2001, health care organizations in the United States employed an estimated 58,000 NPs, two-thirds of whom practiced in adult primary care (Hooker and Berlin 2002; Running et al. 2000). Little research has assessed changes in NP staffing relative to changes in staffing of other primary care clinicians, or the factors shaping changes in staffing mix. To begin to understand what shapes staffing mix, we focused on NP use in primary care and the determinants of their integration into practice. The research presented here adds to previous work by investigating changes in NP staffing patterns over time in Veterans Affairs (VA) primary care practices across the United States, and the characteristics of the practices and their external environments associated with increased reliance on NPs.

Like other managed care organizations, the VA health care system has experienced ongoing pressure over the past decade to contain costs and expand primary care (Kizer, Fonseca, and Long 1997). VA policy has

---

This work was funded by the Department of Veterans Affairs Health Services Research and Development (HSR&D) Service (project no. MPC-97-012) in collaboration with the VA Office of Academic Affiliations.

Address correspondence to Elizabeth M. Yano, Ph.D., Senior Social Scientist, VA Greater Los Angeles HSR&D Center of Excellence, Sepulveda Ambulatory Care Center, 16111 Plummer Street (152), Sepulveda, CA 91343. Patty Y. Huang, M.D., M.P.H., is with the Southern California Permanente Medical Group, Harbor City, CA. At the time the research was performed she was with the VA Greater Los Angeles HSR&D Center of Excellence, VA Greater Los Angeles Healthcare System, Sepulveda, CA. Elizabeth M. Yano, Ph.D., M.S.P.H., and Martin L. Lee, Ph.D., are with the UCLA School of Public Health, Los Angeles. Betty L. Chang, DN.sc., F.N.P., is with the UCLA School of Nursing, Los Angeles. Lisa V. Rubenstein, M.D., M.S.P.H., is with the UCLA Department of Medicine, Los Angeles and the RAND Health Program, Santa Monica, CA.

reflected these pressures by endorsing resource shifts toward primary care, and, as part of this shift, endorsing nonphysician providers (e.g., NPs and physician assistants) as primary care clinicians. In 1994, the VA issued a directive requiring all its facilities to develop primary care programs (Veterans Health Administration 1994), and in 1996, undertook a strategic plan approved by the U.S. Congress to transform its facilities into an integrated delivery system based on ambulatory and primary care. Veterans Affairs leadership anticipated that an undersupply of VA generalist physicians would pose a major challenge to primary care implementation (Rubenstein et al. 1994), and included a mandate to involve more NPs in primary care as part of the reorganization plan (Kizer 1997; Lynn et al. 1999).

Previous research identifies a variety of characteristics of a practice's external environment and internal organizational structure that affect whether practices involve NPs. Among characteristics of the external environment, relative regional shortages of physicians are associated with greater NP utilization (Shi et al. 1993). States with more favorable NP practice laws (e.g., full prescriptive authority) and reimbursement policies also have greater NP supplies (Sekscenski et al. 1994), and practices located in these states use more NPs (Shi and Samuels 1997). Practices located in rural locations often rely on NPs (Krein 1997), and historically, the NP profession developed to provide rural primary care (Abdellah 1982). On the other hand, NPs, like physicians, experience incentives to practice in urban areas (Anderson and Hampton 1999; Pathman et al. 1996). Among characteristics of health care organizations, evidence suggests that prepaid health care systems such as health maintenance organizations (HMOs) have greater economic incentives to hire NPs than do private practices (Leroy 1981; Weiner, Steinbachs, and Williamson 1986; Hooker 1993). Larger organizations also may find it more fiscally attractive to hire NPs, particularly for the delivery of specific services (e.g., preventive care, gynecologic services) (Record et al. 1980). Finally, researchers have investigated a variety of structural characteristics of primary care practices themselves. For example, increased numbers of NPs in primary care may parallel physician numbers (Shi and Samuels 1997) or may be inversely associated with it (indicating possible substitution of NPs for physicians) (Shi et al. 1993). Greater formalization of the NP role (e.g., written job descriptions and medical guidelines) (Zammuto et al. 1979) and affiliations with NP training programs seem to foster greater NP use (Shi et al. 1993).

This study investigates many of the previously identified characteristics of the external environment and internal characteristics of primary care practices, as well as a number of factors that have not been previously

evaluated. We set out to analyze the degree to which VA facilities had incorporated policy changes between 1996 and 1999. Our intent was to identify what the changes were and to what extent internal or external practice environments influenced these events.

## METHODS

### *Data Sources and Data Collection*

The principal data sources for this study include the HRSA State Workforce Profiles (a compilation of information from the Division of Nursing, Bureau of Labor Statistics, American Medical Association, National Council of State Boards of Nursing, and Bureau of the Census), VA utilization databases, previously published studies, and two VA organizational surveys conducted in 1996 and 1999. We measured all organizational characteristics, except the 1999 staffing variables, based on the 1996 survey.

As part of an ongoing national evaluation of VA reorganization toward primary care, we conducted two waves of an organizational key informant survey among the primary care directors at all VA medical centers (VAMCs) nationwide to assess changes in primary care practice structure, staffing, and care arrangements. The first wave (*VHA Survey of Delivery Models in Primary Care*; Yano et al. 1998) was fielded in 1996, concurrent with the early publication of the reorganization strategic plan (*Vision for Change*; Veterans Health Administration 1995). The second wave (*VHA Survey of Primary Care Practices*; Yano et al. 2000; Weeks et al. 2002) was fielded in late 1999, after three years of reorganization activity at the national, regional (health care networks), and local (VA medical center) levels. Response rates were high for both years (100 percent in 1996; 93 percent in 1999), and 148 VAMCs completed surveys during both years. Complete data for the organizational characteristics under study were available for 131 VAMCs, and these sites comprise the study sample. A more detailed description of the survey methodology is described elsewhere (Yano et al. 1998, 2000; Weeks et al. 2002).

### *Measures*

*Environmental Characteristics.* The environmental variables included in the analysis were: (1) geographic region, (2) state practice environment, (3) state NP supply, (4) urban/rural location, and (5) state HMO penetration. The four geographic regions (east, central, south, and west) are standard VA regions

that are similar to U.S. Census Bureau regions (U.S. Census Bureau 2000). Geographic region is included in the analysis as three dummy variables (east, central, and south) with the western region as the reference group.

We determined state practice environment using a previously published 100-point scoring method (Sekscenski et al. 1994) and 1999 legislative information (Pearson 1999). In this scoring method, the state practice environment is a score on a scale of 0 to 100, where 0 points represent state regulations that are least favorable for NPs and 100 points represent the most favorable. Points are given based on three criteria: (1) 20 points if NPs have legal status as professionals, (2) 40 points if reimbursement for NP services is required, and (3) 40 points if NPs have prescriptive authority. Although federal employees, VA NPs are governed by their respective state laws and, hence, their utilization may also be influenced by state NP regulations and policies.

We obtained data about state NP supply (NPs per 100,000 population) from the HRSA State Workforce Profiles (Bureau of Health Professions 2000). Veterans Affairs medical centers were designated as "urban" if respondents to the 1996 VA primary care survey indicated that their VA location was a large or small city and "rural" if respondents indicated a semi-rural or rural area.

State HMO penetration is the percentage of a state's population enrolled in an HMO insurance plan. State HMO penetration was calculated by dividing the number of HMO enrollees by the state population (based on U.S. Census figures), and data were obtained from the Managed Care Digest Series (SMG Marketing Group 2000). We include this variable in the analysis because evidence suggests that prepaid health care systems such as HMOs use NPs as part of their cost-containment strategy (LeRoy 1981; Hooker 1993; Palsbo 1994). Local culture and exposure to common contextual factors can influence the adoption of similar practice features, such as staffing patterns, across all types of organizations (Meyer and Rowan 1977; DiMaggio and Powell 1983). Therefore, VA practices in regions with higher HMO penetration may also use more NPs. However, the relationship between HMO penetration and NP use has not been previously examined.

*Organizational Characteristics.* We obtained data on the organizational variables from the 1996 and 1999 VA primary care surveys. The organizational variables examined in the analysis include: (1) the number of primary care NP full-time equivalent employees (FTEs), (2) the number of physician (general internal medicine and subspecialty) FTEs allocated to the primary care practice, (3) the number of primary care physician assistant (PA) FTEs, (4) whether the practice provided outpatient primary care training for NP

trainees, (5) facility complexity, (6) academic affiliation, (7) whether or not the primary care practice was organized into a team-based delivery model called a “primary care firm system,” and (8) the use of five managed care arrangements.

The measure of facility complexity is a standardized 100-point score, and each VAMC’s score is derived as a weighted function of facility size (e.g., number of beds), clinical variety (e.g., scope of available services), and academic mission (e.g., number and variety of training and research programs) (Stefos, LaValle, and Holden 1992). Facility complexity was assessed using administrative data from the VA Office of Policy and Planning. Academic affiliation was based on whether survey respondents indicated an affiliation with a medical school.

Primary care practices were designated as “primary care firm systems” if they answered affirmatively on the survey to having multidisciplinary teams with providers responsible for the inpatient and outpatient care of an assigned panel of patients, maintained longitudinal relationships with their patients, and had an administrator dedicated to clinic operations. The VA primary care firm systems are based on firm systems previously described in the literature (Rubenstein et al. 1996; Smith 1995; Landefeld and Aucott 1995).

The five managed care arrangements examined were: (1) “gate-keeping” or use of primary care providers to coordinate care and control specialty referrals and tests, (2) preauthorization for tests, procedures, and specialty referrals, (3) profiling of provider utilization patterns, (4) practice guideline implementation, and (5) managed-care-oriented provider education programs. We assessed the use of these managed care arrangements by creating scales from survey answers. The managed care scales were adapted from previously published utilization management measures, and higher values on the scales represent greater use of each managed care arrangement (Kerr et al. 1995, 2000). Managed care scales were fielded in the 1999 survey only.

### *Statistical Analysis*

The study is a facility-level analysis since each VAMC has only one primary care practice. Thus, practice characteristics such as the use of managed care arrangements and the numbers and rates of primary care clinicians (e.g., number of primary care NPs and rate of primary care NPs/10,000 primary care patients) are facility-level data.

We performed descriptive analysis, including t-tests, to assess changes in NP staffing patterns between 1996 and 1999. The mean number of NPs and mean rate of NPs/10,000 primary care (PC) patients across all VA primary care practices were calculated for both years. The rate of NPs/10,000 PC patients was obtained by dividing the number of NP FTEs at a given practice by the number of unique PC patients served per VAMC for the respective year. The resulting number was then multiplied by 10,000 to express the number as NPs/10,000 PC patients. Unique PC patients in 1996 or 1999 are those patients with at least one primary care visit during fiscal years 1996 (October 1, 1995, through September 30, 1996) or 1999 (October 1, 1998, through September 30, 1999). This data was obtained from VA Austin Automation Center's Outpatient Clinic File (Murphy et al. 2002).

We describe NP staffing in relation to staffing of other primary care clinicians, which include physicians (general internal medicine and specialty-trained), physician assistants (PAs), and total primary care clinicians (NPs, PAs, and physicians). The total number of primary care clinicians was defined as the sum of the number of NP, physician, and PA FTEs allocated to the primary care practice. We calculated the mean numbers and rates of physicians, PAs, and total primary care clinicians as well as the mean NP-per-physician ratio. The rates of physicians/10,000 PC patients, PAs/10,000 PC patients, and total PC clinicians/10,000 PC patients were derived using the same method described for NPs/10,000 PC patients. NP-per-physician ratios were calculated by dividing the number of NP FTEs by the number of physician FTEs.

In order to examine the influence of environmental and organizational predictors on the number of NPs/10,000 PC patients in 1999, we first performed bivariate analyses to screen the predictors for their potential use in a multivariate linear regression model at the level of  $\alpha = .20$  (Mickey and Greenland 1989). Square-root transformation of the dependent variable (NPs/10,000 PC patients in 1999) was used to more closely approximate its distribution to normality. Square-root and logarithmic transformations were performed on some of the independent variables for similar reasons.

For the bivariate analyses, we used Pearson correlation to assess for relationships between continuous variables (e.g., state NP supply, managed care arrangement scales) and the dependent variable. To compare the mean number of NPs/10,000 PC patients for categorical variables (e.g., academic-affiliated versus nonaffiliated, urban versus rural), we used independent sample t-tests and one-way analyses of variance (ANOVA).

With the independent variables that remained after the initial screening process, we used forward stepwise regression ( $p < .10$ ) for multivariate model selection and performed cross-validation to minimize potential order effect bias associated with stepwise variable selection (Bendel and Afifi 1977; Urban Hjorth 1994). In the multivariate model, we also controlled for the number of NPs/10,000 PC patients in 1996. We kept the independent variables that appeared most frequently during 30 cross-validation runs in the final multivariate model. While we also created and tested interaction terms, they did not improve on the final model.

## RESULTS

### *Characteristics of VA Primary Care Practices*

Table 1 summarizes descriptive statistics of the 131 VA primary care practices included in the study. The practices were distributed across four geographic regions, with the greatest number located in the central region of the United States (29 percent) and the least in the west (18 percent). On average, the health care environment of the study practices had an HMO penetration of 33 percent (range 4.2 to 65.3 percent), NP practice environment score of 74.1 (range 35 to 100), and the NP supply was 26.7 NPs/100,000 population (range 7.4 to 57 NPs/100,000 population).

Most practices were academically affiliated (70 percent) and located in urban areas (69 percent). More than half (56 percent) of the practices had NP training programs, and only 21 percent organized themselves in a "firm system." The mean facility complexity score of the VAMCs in the study was 41. Of the five managed care arrangements, VA primary care practices have primarily implemented gate-keeping and practice guidelines, rather than provider education, profiling, and preauthorization.

### *NP Staffing Patterns in 1996 and 1999*

In 1996, 75 percent (98/131) of VA primary care practices reported using NPs, and in 1999, 90 percent (118/131) of practices used NPs. Table 2 summarizes staffing patterns and patient volume across the VA practices in 1996 and 1999. During this period, the mean number of primary care patients per VAMC also increased significantly ( $p < .0001$ ). The increase in the mean number of NPs per primary care practice from 2.0 in 1996 to 3.2 in 1999 is statistically significant ( $p < .001$ ). During this same period, the mean numbers of physicians and PAs per practice remained stable, while the mean number of



Table 1: Characteristics of VA Facilities Surveyed in 1996 (N= 131)

	<i>Mean</i>	<i>Standard Deviation</i>
<b>Environmental Characteristics</b>		
Geographic Region (%)		
East	27	
Central	29	
South	26	
West	18	
State NP practice environment (range 0–100)	74.1	15.7
State NP supply (NPs/100,000 population)	26.7	12.5
State HMO penetration (range 0–100%)	32.9	15.3
<b>Organizational Characteristics</b>		
Academically affiliated (%)	70	
Urban location (%)	69	
Team-based delivery model (“Firm system”) (%)	21	
NP training program (%)	56	
Facility complexity (range 0–10)	40.6	23.8
Managed care arrangement scales		
Gate-keeping (range 0–10)	8.7	1.6
Profiling (range 0–9) <sup>†</sup>	2.5	0.5
Preauthorization (range 0–7) <sup>†</sup>	1.2	0.4
Managed-care-oriented provider education (range 0–8)	3.4	1.8
Practice guidelines (range 0–8)	6.9	1.1

NP = nurse practitioner.

<sup>†</sup>Square-root transformation of the variable was performed to achieve approximate normality.

*Note:* On the transformed variables, the means are based on initially transforming the data, performing the calculations on the transformed results, and then reversing the transformation to obtain the values presented in the table.

total PC clinicians increased (12.6 PC clinicians in 1996; 14.5 PC clinicians in 1999;  $p < .05$ ).

Looking at the rates, there was no significant change in the mean rate of NPs/10,000 PC patients between 1996 and 1999. However, the decreases in the mean rates of physicians/10,000 PC patients and total PC clinicians/10,000 PC patients are both statistically significant ( $p < .01$ ).

The increase in the NP-per-physician ratio from 0.2 (or 1 NP per 5 physicians) to 0.4 (or 2 NPs per 5 physicians) was also significant ( $p < .001$ ).

### *Factors Associated with Greater NP Use*

On bivariate analysis, we found higher NP use among VA primary care practices located in states with greater HMO penetration ( $r = 0.19$ ,  $p = .03$ )

Table 2: Mean Values for Staffing Patterns and Patient Volume across VA Primary Care Practices—1996, 1999 (Standard deviation presented within parentheses.)

	1996	1999
Primary care (PC) patients per VAMC	9,160 (4,251)	12,481 (5,621)**
Numbers of clinicians per PC practice by type		
Nurse practitioners (NPs) <sup>†</sup>	2.0 (1.0)	3.2 (0.8)**
Physicians <sup>‡</sup>	8.3 (2.2)	8.9 (2.0)
Physician assistants (PAs) <sup>‡</sup>	1.2 (2.5)	1.4 (2.5)
PC clinicians (NPs, physicians, PAs) <sup>‡</sup>	12.6 (2.0)	14.5 (1.8)**
Rates of clinicians per PC practice by type		
NPs/10,000 PC patients <sup>†</sup>	2.2 (1.0)	2.7 (0.7)
Physicians/10,000 PC patients <sup>‡</sup>	10.0 (2.0)	7.9 (1.8)**
PAs/10,000 PC patients <sup>‡</sup>	1.4 (2.8)	1.2 (2.5)
PC clinicians/10,000 PC patients <sup>‡</sup>	15.1 (1.7)	12.9 (1.5)**
NP-per-physician ratio <sup>†</sup>	0.2 (0.1)	0.4 (0.1)**

\*\*1999 mean is statistically different compared to 1996 mean ( $p < .05$ ).

<sup>†</sup>Square-root transformation of the variable was performed to achieve approximate normality.

<sup>‡</sup>Logarithmic transformation of the variable was performed to achieve approximate normality.

Note: On the transformed variables, the means are based on initially transforming the data, performing the calculations on the transformed results, and then reversing the transformation to obtain the values presented in the table.

and NP supply ( $r = 0.17$ ,  $p = .05$ ). Greater NP involvement in primary care was also found among VA practices located in the western region of the United States ( $p = .04$ ) and urban areas ( $p = .01$ ). Organizational characteristics associated with greater NP use were academic affiliation ( $p = .04$ ), having NP trainees ( $p = .01$ ), higher facility complexity ( $r = 0.21$ ,  $p = .02$ ), and greater reliance on managed-care-oriented provider education programs ( $r = 0.16$ ,  $p = .07$ ). Practices that did not organize themselves in “firm systems” ( $p = .05$ ) and used more specialist physicians/10,000 PC patients ( $r = 0.17$ ;  $p = .05$ ) to deliver primary care also involved more NPs.

After multivariable adjustment (Table 3) and controlling for NPs/10,000 PC patients in 1996, practices that used more managed care-oriented provider education programs ( $p = .02$ ) and provided NP training ( $p = .05$ ) used more NPs/10,000 PC patients in 1999. The overall adjusted R-square of the model is 0.21. In the multivariate analysis, practices with higher rates of specialist physicians/10,000 PC patients ( $p = .09$ ) were also associated with higher NP use, but this trend did not reach statistical significance at the 5 percent level.

Table 3: Primary Care Practice Characteristics Associated with Using More NPs/10,000 PC Patients in 1999, Controlling for NPs/10,000 PC Patients in 1996\*

<i>Independent Variable</i>	<i>Parameter Estimate</i>	<i>Standard Error</i>	<i>P-Value</i>	<i>95% CI</i>
Intecept	.80	.19	<.0001	(0.42, 1.18)
NPs/10,000 PC patients in 1996	.31	.07	<.0001	(0.17, 0.44)
Managed-care-oriented provider education programs	.09	.04	.02	(0.02, 0.16)
NP training program	.26	.13	.05	(0.005, 0.52)
Specialist physicians/10,000 PC patients	.13	.08	.09	(- 0.02, 0.29)

\**Note:* We performed bivariate analyses to screen predictors for their potential use in a multivariate linear regression model at the level of alpha = .20. Twelve predictors remained after the screening process: geographic region, urban/rural location, state NP supply, state HMO penetration, academic affiliation, specialist physicians/10,000 PC patients, facility complexity, use of managed-care-oriented provider education, practice guidelines implementation, gate-keeping, primary care firm systems, and whether the practice provided NP training. We entered these 12 variables into multivariate model selection and cross-validation. The variables shown in Table 3 appeared most frequently during the 30 cross-validation runs. (Adjusted R-square = .21)

## DISCUSSION

Over the past 20 years, researchers (Yano et al. 1995; Bodenheimer, Wagner, and Grumbach 2002; Safran 2003; Scheffler 1996) and policy analysts (Donaldson et al. 1996; Institute of Medicine 2001) have identified the interdisciplinary primary care team as a critical component of a better health care system. In the United States, nurse practitioners are one of the most commonly employed nonphysician clinicians, yet few studies have evaluated their progress in establishing a place within typical primary care settings. The VA health care system includes more than 100 facilities that incorporate primary care practices, and these facilities vary substantially in geography, history, and primary care arrangements. We found that faced with a constrained budget and backed by policies favorable to NPs, VA medical centers substantially increased the numbers of NPs used in primary care and saw 40 percent more patients between 1996 and 1999. The number of primary care NPs increased on average by about 60 percent from two NPs per practice to over three per practice. On the contrary, the mean numbers of PAs and physicians per practice remained relatively stable during this period. These results indicate increased VA primary care productivity in parallel with increased use of NPs in VA primary care teams. Future research to understand

exactly how NPs are functioning within primary care teams and evaluate quality of care in relationship to staffing mix is needed.

Primary care practices in the western United States used more NPs. Not surprisingly, states in the west were also characterized by factors previously shown to be associated with greater NP utilization, including a significantly greater supply of NPs ( $p = .01$ ), more favorable NP practice environments ( $p < .001$ ), and higher HMO penetration ( $p = .001$ ). From our data, we do not know whether these western state characteristics are a manifestation of complex and difficult to replicate organizational and cultural features that are unique to this region, or whether changing state regulations or increasing NP supply in other regions would result in similarly high NP utilization (Safriet 1994; Shi and Samuels 1997; Pearson 1999).

Contrary to our expectations from the literature, we found that urban or academic VA practices used more NPs than rural or nonacademic practices. Veterans Affairs practices that involved more NPs in primary care were also less likely to organize themselves into primary care firm systems and had more specialist (versus generalist) physicians delivering primary care. We suspect that urban, complex, highly specialized medical centers with large physician staffs may have had more difficulty shifting their physician workforces toward primary care. Given fixed budgets, they may have found hiring NPs a more feasible alternative than either shifting more specialist physicians to work in primary care or reducing the number of specialist physicians in order to hire more generalists.

Our multivariate regression findings suggest that the educational environment within primary care is important in increasing a practice's use of NPs. In multivariate regressions holding region, state characteristics, urban location, and the associated organizational characteristics discussed above constant, and controlling for the rate of NPs in 1996 (Table 3), we found that practices that delivered NP training and more managed-care-oriented provider education were the most likely to increase their rate of NPs/10,000 PC patients by 1999. This finding may be particularly interesting to primary care practices wishing to attract NPs, in that location and its associated characteristics are difficult or impossible to change, while the educational environment can be altered.

The finding that managed care education in primary care is associated with rising NP use may also indicate that NPs are often hired by practices transitioning from an emphasis on hospital and specialist care to managed care, with its inherent primary care demands. Survey questions on managed-care-oriented education asked about the use of retreats, seminars, and didactic

sessions to instruct providers about cost-effective and evidence-based practice; these types of educational initiatives are often undertaken as preparation for change. Likewise, the involvement of specialist physicians in primary care often occurs early in the transition toward a managed care focus, as specialist physicians are reassigned to primary care to meet increasing needs. The other managed care arrangements that we studied, such as profiling of provider utilization patterns and preauthorization for procedures, tests, or referrals, were not significant in predicting increased NP use in 1999. These arrangements may require a higher level of development of managed care, and may indicate programs that were more mature in 1996 and hence less likely to increase their NP numbers by 1999.

The study has several limitations. First, while we were able to capitalize on the opportunity to conduct a natural experiment as VA organization unfolded nationwide, we understand that increased NP use was only one of a very long list of policy initiatives employed as part of the strategic plan. Therefore, as a policy analysis, we had no mechanism to assess how NP staffing patterns may have changed on its own in the absence of the policy encouraging greater NP use (i.e., no comparison or control group). However, as a hierarchically managed federal agency, it is difficult to suggest that such a rapid change in NP staffing would be possible if it relied upon local or regional innovation rather than a national policy supported by organizational leadership. Second, while we identified important environmental and organizational factors that may foster local practices' ability to increase NP use, the observational nature of this study prevents us from concluding that these factors are causal in nature. Finally, many of the organizational variables we examined (e.g., use of managed care arrangements, presence of "firm systems") are based on self-report data from the survey of primary care directors. In light of the VA directive to reorganize with a greater emphasis on primary care, respondents may have biased their answers to reflect practices consistent with primary care goals (e.g., greater use gate-keeping, providers responsible for inpatient and outpatient care of their panel of patients). If so, a large number of facilities were still willing to disclose a lack of primary care orientation on these questions, and as a validation strategy, we comprehensively assessed survey question integrity through site visits to six VA medical centers.

Finally, our findings that organizational factors were significant predictors of NP use establishes domains that will be important to examine in future research about NP practice. Specifically, current research on NP topics such as their practice styles, care models, and outcomes is a broad and

largely undifferentiated field. However, in our study, we identify organizational characteristics that lead to greater NP use in primary care, that is, having NP trainees, more specialist physicians, and greater primary care education needs. Since practices with these characteristics involve more NPs, these practices may be inherently “different” in their relationship with NPs, how they utilize these clinicians, and whether these organizational features may influence how NPs practice. Future studies to understand how NPs function in primary care settings with these characteristics would be valuable for the strategic planning in primary care. Thoughtful, informed decision making about primary care staffing can occur only when we know more about what care models are being used, the contextual factors driving care models, and when these models do and do not work effectively.

This article evaluates the degree to which VA facilities incorporated NPs into primary care between 1996 and 1999, and how different types of facilities responded to the changing NP policy as well as the internal and external practice environment. While we expect that our findings will apply most directly to the VA itself and to the large, nonprofit, staff-model managed care organizations it resembles (Meredith et al. 1999), we anticipate that our analyses will also stimulate additional thought and investigation among policymakers, nurse educators, primary care leaders, and researchers as they seek to understand and guide the development of primary care teams.

## REFERENCES

- Abdellah, F. G. 1982. “The Nurse Practitioner 17 Years Later: Present and Emerging Issues.” *Inquiry* 19 (1): 105–16.
- Anderson, D. M., and M. B. Hampton. 1999. “Physician Assistants and Nurse Practitioners: Rural-Urban Settings and Reimbursement for Services.” *Journal of Rural Health* 15 (2): 252–63.
- Bendel, R. B., and A. A. Afifi. 1977. “Comparison of Stopping Rules in Forward ‘Stepwise’ Regression.” *Journal of the American Statistical Association* 72: 46–53.
- Bodenheimer, T., E. H. Wagner, and K. Grumbach. 2002. “Improving Primary Care for Patients with Chronic Illness.” *Journal of the American Association* 288 (14): 1775–9.
- Brown, S. A., and D. E. Grimes. 1995. “A Meta-Analysis of Nurse Practitioners and Nurse Midwives in Primary Care.” *Nursing Research* 44 (6): 332–9.
- Bureau of Health Professions, National Center for Health Workforce Information and Analysis 2000. “HRSA State Health Workforce Profiles” [accessed on January 12, 2001] [Electronic version]. Rockville, MD: U.S. Department of Health and

- Human Services. Available at <http://bhpr.hrsa.gov/healthworkforce/profiles/default.htm>.
- Dial, T. H., S. E. Palsbo, C. Bergsten, J. R. Gabel, and J. Weiner. 1995. "Clinical Staffing in Staff- and Group-Model HMOs." *Health Affairs* 14 (2): 168-80.
- DiMaggio, P. J., and W. W. Powell. 1983. "The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields." *American Sociological Review* 48 (April): 147-60.
- Donaldson, M. S., K. D. Yordy, K. N. Lohr, and N. A. Vaneslow. 1996. *Primary Care: America's Health in a New Era*. Washington, DC: National Academy Press.
- Hooker, R. S. 1993. "The Roles of Physician Assistants and Nurse Practitioners in a Managed Care Organization." In *The Role of Physician Assistants and Nurse Practitioners in Primary Care*, edited by D. K. Clawson and M. Osterweis, pp. 51-67. Washington, DC: Association of Academic Health Centers.
- Hooker, R. S., and L. E. Berlin. 2002. "Trends in the Supply of Physician Assistants and Nurse Practitioners in the United States." *Health Affairs* 21 (5): 174-81.
- Horrocks, S., E. Anderson, and C. Salisbury. 2002. "Systematic Review of Whether Nurse Practitioners Working in Primary Care Can Provide Equivalent Care to Doctors." *British Medical Journal* 324 (7341): 819-23.
- Institute of Medicine. 2001. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: National Academy Press.
- Kerr, E. A., B. S. Mittman, R. D. Hays, A. L. Siu, B. Leake, and R. H. Brook. 1995. "Managed Care and Capitation in California: How Do Physicians at Financial Risk Control Their Own Utilization?" *Annals of Internal Medicine* 123 (7): 500-4.
- Kerr, E. A., B. S. Mittman, R. D. Hays, J. K. Zemencuk, J. Pitts, and R. H. Brook. 2000. "Associations between Primary Care Physician Satisfaction and Self-reported Aspects of Utilization Management." *Health Services Research* 35 (1, part 2): 333-49.
- Kizer, K. W. 1997. *Prescription for Change*. Washington, DC: Department of Veteran Affairs.
- Kizer, K. W., M. L. Fonseca, and L. M. Long. 1997. "The Veterans Healthcare System: Preparing for the Twenty First Century." *Hospital Health Services Administration* 42 (3): 283-98.
- Krein, S. L. 1997. "The Employment and Use of Nurse Practitioners and Physician Assistants by Rural Hospitals." *Journal of Rural Health* 13 (1): 45-58.
- Lamoreaux, J. 1996. "The Organizational Structure for Medical Information Management in the Department of Veterans Affairs: An Overview of Major Health Care Databases." *Medical Care* 34 (3, supplement): MS31-44.
- Landefeld, C. S., and J. Aucott. 1995. "Improving Primary Care in Academic Medical Centers: The Role of Firm Systems." *Medical Care* 33 (3): 311-4.
- LeRoy, L. 1981. *Case Study 16: The Costs and Effectiveness of Nurse Practitioners*. Washington, DC: Office of Technology Assessment.
- Lewis, C. E., and B. A. Resnik. 1967. "Nurse Clinics and Progressive Ambulatory Patient Care." *New England Journal of Medicine* 277 (23): 1236-41.

- Lowes, R. L. 1998. "Making Midlevel Providers Click with Your Group." *Medical Economics* 75 (7): 123-38.
- Lynn, M. M., C. Achtmeyer, C. Chavez, B. Zicafoose, and J. Therien. 1999. "The Evolving Role of Advanced Practice Nursing within the New Veterans' Health Administration." *Health Care Management Review* 24 (4): 80-93.
- Meredith, L. S., L. V. Rubenstein, K. Rost, D. Ford, N. Gordon, P. Nutting, P. Camp, and K. B. Wells. 1999. "Treating Depression in Staff-Model Versus Network-Model Managed Care Organizations." *Journal of General Internal Medicine* 14 (1): 39-48.
- Meyer, J. W., and B. Rowan. 1977. "Institutionalized Organizations: Formal Structures as Myth and Ceremony." *American Journal of Sociology* 83 (2): 340-63.
- Mickey, R. M., and S. Greenland. 1989. "A Study of the Impact of Confounder Selection Criteria on Effect Estimation." *American Journal of Epidemiology* 129 (1): 125-37.
- Murphy, P. A., D. C. Cowper, G. Seppala, K. T. Stroupe, and D. M. Hynes. 2002. "Veterans Health Administration Inpatient and Outpatient Care Data: An Overview." *Effective Clinical Practice* 5 (3, supplement): E4.
- Office of Technology Assessment, U.S. Congress. 1986. *Nurse Practitioners, Physician Assistants, and Certified Nurse Midwives: A Policy Analysis*, Health Technology Care Study 37. Washington, DC: Government Printing Office.
- Palsbo, S. 1994. "Six Keys to Cost-effective Health Care." *Journal of Health Care Benefits* 4 (2): 46-50.
- Pathman, D. E., E. S. Williams, and T. R. Konrad. 1996. "Rural Physician Satisfaction: Its Sources and Relationship to Retention." *Journal of Rural Health* 12 (5): 366-77.
- Pearson, L. J. 1999. "Annual Update of How Each State Stands on Legislative Issues Affecting Advanced Nursing Practice." *Nurse Practitioner* 24 (1): 16-83.
- Record, J. C., M. McCally, S. O. Schweitzer, R. M. Blomquist, and B. D. Berger. 1980. "New Health Professional after a Decade and a Half: Delegation, Productivity, and Costs in Primary Care." *Journal of Health, Politics, Policy, and Law* 5 (3): 470-97.
- Reinhardt, U. E. 1975. *Physician Productivity and the Demand for Health Manpower*. Cambridge, MA: Ballinger.
- Rogers, B., S. Sweeting, and B. Davis. 1989. "Employment and Salary Characteristics of Nurse Practitioners." *Nurse Practitioner* 14 (9): 56-66.
- Rubenstein, L. V., B. Simon, E. M. Yano, A. Lanto, and M. Wang. 1994. *Veterans Health Administration Readiness for Managed Care*. Sepulveda, CA: Center for the Study of Healthcare Provider Behavior.
- Rubenstein, L. V., E. M. Yano, A. Fink, A. B. Lanto, B. Simon, M. Graham, and A. S. Robbins. 1996. "Evaluation of the VA's Pilot Program in Institutional Reorganization toward Primary and Ambulatory Care: Part I, Changes in Process and Outcomes of Care." *Academic Medicine* 71 (7): 772-83.
- Running, A., J. Calder, B. Mustain, and C. Foreschler. 2000. "A Survey of Nurse Practitioners across the United States." *Nurse Practitioner* 25 (6, part 1): 15-6, 110-6.



- Safran, D. G. 2003. "Defining the Future of Primary Care: What Can We Learn from Patients?" *Annals of Internal Medicine* 138 (3): 248–55.
- Safriet, B. J. 1992. "Health Care Dollars and Regulatory Sense." *Yale Journal of Regulation* 9 (2): 417–87.
- . 1994. "Impediments to Progress in Health Care Workforce Policy: License and Practice Laws." *Inquiry* 31 (3): 310–7.
- Scheffler, R. M. 1996. "Life in the Kaleidoscope: The Impact of Managed Care on the U.S. Health Care Workforce and a New Model for the Delivery of Primary Care." In *Primary Care: America's Health in a New Era*, edited by M. S. Donaldson, K. D. Yordy, K. N. Lohr, and N. A. Vaneslow, pp. 312–40. Washington, DC: National Academy Press.
- Sekscenski, E. S., S. Sansom, C. Bazell, M. E. Salmon, and F. Mullan. 1994. "State Practice Environments and the Supply of Physician Assistants, Nurse Practitioners, and Certified Nurse Midwives." *New England Journal of Medicine* 331 (19): 1266–71.
- Shi, L., and M. E. Samuels. 1997. "Practice Environment and the Employment of Nurse Practitioners, Physician Assistants, and Certified Nurse Midwives by Community Health Centers." *Journal of Allied Health* 26 (3): 105–11.
- Shi, L., M. E. Samuels, T. R. Konrad, T. C. Ricketts, C. H. Stoskopf, and D. L. Richter. 1993. "The Determinants of Utilization of Nonphysician Providers in Rural Community and Migrant Health Centers." *Journal of Rural Health* 9 (1): 27–39.
- SMG Marketing Group. 2000. "HMO Penetration, by State and Region" [accessed on April 10, 2001] in *eHMO-PPO/Medicare-Medicaid Digest*. Available at <http://www.managedcaaredigest.com/edigests/hm2000/>.
- Smith, C. S. 1995. "The Impact of an Ambulatory Firm System on Quality and Continuity of Care." *Medical Care* 33 (3): 221–6.
- Spizter, W. O., D. L. Sackett, J. C. Sibley, R. S. Roberts, M. Gent, D. J. Kergin, B. C. Hackett, and C. A. Olynich. 1974. "The Burlington Randomized Trial of the Nurse Practitioner." *New England Journal of Medicine* 290 (5): 251–6.
- Stefos, T., N. LaValle, and F. Holden. 1992. "Fairness in Prospective Payment: A Clustering Approach." *Health Services Research* 27 (2): 239–61.
- Urban Hjorth, J. S. 1994. *Computer Intensive Statistical Methods*. London: Chapman & Hall.
- U.S. Census Bureau. 2000. "Census Regions and Divisions of the United States" [accessed on March 27, 2002] [Electronic version]. Washington, DC: U.S. Department of Commerce. Available at [http://www.census.gov/geo/www/us\\_regdiv.pdf](http://www.census.gov/geo/www/us_regdiv.pdf).
- Veterans Health Administration. 1994. *Guidance for the Implementation of Primary Care in Veterans Health Administration*, VHA Directive 10-94-100. Washington, DC: Department of Veterans Affairs.
- . 1995. *Vision for Change: A Plan to Restructure the Veterans Health Administration*. Washington, DC: Department of Veterans Affairs.
- Weeks, W. B., E. M. Yano, and L. V. Rubenstein. 2002. "Primary Care Practice Management in Rural and Urban Veterans Health Administration Settings." *Journal of Rural Health* 18 (2): 298–303.

- Weiner, J., D. M. Steinbachs, and J. W. Williamson. 1986. "Nurse Practitioner and Physician Assistant Practices in Three HMOs: Implications for Future U.S. Health Manpower Needs." *American Journal of Public Health* 76 (5): 506–11.
- Yano, E. M., A. Fink, S. H. Hirsch, A. S. Robbins, and L. V. Rubenstein. 1995. "Helping Practices Reach Primary Care Goals: Lessons from the Literature." *Archives of Internal Medicine* 155 (11): 1146–56.
- Yano, E. M., B. Simon, I. Canelo, A. B. Lanto, and L. V. Rubenstein. 1998. *VHA Survey of Delivery Models for Primary Care: Results of a National Survey*. Sepulveda, CA: Center for the Study of Healthcare Provider Behavior.
- . 2000. *Managed Care Performance of VHA Primary Care Delivery Systems*. Sepulveda, CA: Center for the Study of Healthcare Provider Behavior.
- Zammuto, R. F., I. R. Turner, S. Miller, I. Shannon, and J. Christian. 1979. "Effect of Clinical Settings on the Utilization of Nurse Practitioners." *Nursing Research* 28 (2): 98–102.