Rural nurse anesthesia practice: A pilot study

Elizabeth Monti Seibert, CRNA, MSN
Richmond, Virginia

Judith Alexander, RN, PhD
Columbia, South Carolina

Alfred E. Lupien, CRNA, PhD
Augusta, Georgia

Certified Registered Nurse Anesthetists (CRNAs) have been identified as the predominant anesthesia providers in rural areas; however, little information is available about the types of services provided by rural CRNAs. The purposes of this study were to pilot test the Nurse Anesthesia Rural Practice Inventory (NARPI); determine whether CRNAs can provide the requested data; and provide data about characteristics of rural nurse anesthesia practice. The NARPI is a newly developed, self-administered questionnaire containing 39 items related to anesthesia practice. The survey was mailed to a stratified convenience sample of 146 actively practicing CRNAs living in rural areas. Of the 33 surveys returned (23%), 28 were usable for data analysis with descriptive statistics.

The findings revealed that rural CRNAs provide a broad range of anesthesia and anesthesia-related services within and outside the operating room and support the American Association of Nurse Anesthetists' statement that CRNAs are the predominant anesthesia providers in rural areas. Significant differences were found in the employment settings of independent and medically directed CRNAs, the availability of certain anesthetic agents and monitoring devices, and the representation of surgical specialists based on community and hospital size. The NARPI has the potential to provide needed information about rural anesthesia practice in future studies.

Key words: **Anesthesia manpower, nurse anesthetist, rural.**

Certified Registered Nurse Anesthetists (CRNAs) are the predominant providers of anesthesia services in rural areas of the United States.[1-3] Of the anesthesia care provided in rural hospitals, 70% is provided by CRNAs, and 37% of nurse anesthetists practice in towns with fewer than 50,000 residents.[3] Despite the widespread utilization of CRNAs in rural communities, little information is available about the types of anesthetic and ancillary services that rural CRNAs provide.

Most insight into rural anesthesia practice has been derived from the surgical literature. In 1994, Callaghan[4] reported the outcomes of 13,793 general surgical, orthopedic, urological, gynecological, and obstetrical operations performed in a 50-bed facility during a 25-year period. One nurse anesthetist provided anesthesia services during this entire timeframe. Overall surgical morbidity and mortality rates were "comparable with those published from larger medical centers."[4(p465)] Invasive hemodynamic monitoring and postoperative ventilator support were not available in the facility.

The experiences of 7 surgeons in 9 rural midwestern communities were reported by Landercasper and colleagues.[5] Each of the communities had populations of fewer than 9,000 residents, and the hospitals ranged in size from 22 to 53 beds. During a 15-month period, CRNAs were the sole anesthesia providers for 2,420 surgical procedures. Unfortunately, the authors did not report morbidity and mortality rates.

The scope of general surgical practice in 48 Georgia towns with populations of fewer than 25,000 was examined by Herring.[6] The hospitals in this study, reported in 1986, ranged in size from 35 to 462 beds. Nurse anesthetists practiced in all but 2 of these communities and were the sole providers of anesthesia in 10 of 19 towns with fewer than 7,500 residents. In this study, anesthesiologists were more likely to be available as the size of the community increased.

These descriptive studies of surgical practices confirm the presence of nurse anesthetists in rural communities; however, they do not indicate the scope of services provided by rural CRNAs. More detailed information about rural anesthesia practice is required to serve as benchmarks for individuals currently practicing in rural communities, CRNAs considering relocation to practice in a rural setting, and educators developing didactic and clinical experiences for graduates who intend to practice in rural settings.

Rural communities commonly have difficulty recruiting and retaining healthcare providers.[7,8] The expected retirement of approximately 25% of nurse anesthetists during the next 10 to 15 years[9] compounds the current shortage of anesthesia providers and has a significant impact on the ability of small hospitals to provide surgical and obstetrical services.[10] Although not often viewed from an economic

perspective, CRNAs serve as part of the foundation for the long-term viability of rural communities. Access to quality healthcare is essential to the economic health of a community,[11-13] surgical services are essential for the economic health of a hospital,[14] and anesthesia services are a requirement for the provision of surgical care. Therefore, a more detailed description of the roles and services of CRNAs in the rural community is essential.

Purpose

This study was designed to pilot test the Nurse Anesthesia Rural Practice Inventory (NARPI). The instrument was designed to provide initial descriptive data about characteristics of rural anesthesia and surgical practices, and determine whether rural CRNAs could provide the data requested. Findings from this study will aid in identifying and revising problematic areas of the NARPI before conducting a large-scale study of rural CRNAs. The NARPI is discussed further in the Methods section.

Methods

The NARPI is a 53-item self-administered questionnaire consisting of 39 items about anesthesia practice and the 14-item Alexander Organizational Structure Instrument. One of us (E.M.S.) adapted and expanded the anesthesia items from a questionnaire developed by the AANA Foundation for a study of closed malpractice insurance claims (L. Jordan, personal written communication, March 2000). Content validity of the anesthesia-related items was determined by a review of the literature and an expert panel. The panel consisted of 2 groups of rural CRNAs who reviewed the instrument at professional association meetings. The 14-item organizational structure instrument was adapted by Alexander[15] from the work of Leifer and Huber.[16] It has been used in a variety of settings to examine characteristics of relationships among nursing personnel[17,18] but has not been used with nurse anesthetists. The results of the Alexander Organizational Structure Instrument items are not described in this report.

A convenience sample of 150 CRNAs living in rural areas was identified from the membership roster of the American Association of Nurse Anesthetists (AANA). Inclusion criteria were as follows: certification as a nurse anesthetist by the Council on Certification of Nurse Anesthetists, active membership status in the AANA, and actively engaged in anesthesia practice. Rural areas were defined as communities meeting the criteria for codes 4 through 9 of the Rural-Urban Continuum Scale.[15] Zip codes were used to match place of residence with the Rural-Urban Continuum Scale. The sample was stratified to select 3 CRNAs from each state. However, only 146 CRNAs could be identified as living in rural areas when zip codes were verified with a rural-urban zip code locator. Following approval by the human assurance and nursing ethics committees, a cover letter explaining the purpose of the study, a self-administered questionnaire, and a return envelope were mailed to the sample. A reminder postcard was sent 1 month after the initial mailing. SAS software (version 8.02, SAS Institute, Cary, NC) was used to analyze the data using descriptive statistics. Results were considered significant if the *P* value was less than .05.

Table 1. Distribution of facilities by community size*

Community size	Bed size of facility < 100	> 100	Total
< 10,000	11 (41)	0 (0)	11 (41)
10,000-49,999	6 (22)	6 (22)	12 (44)
> 50,000†	2 (7)	2 (7)	4 (15)
Total	19 (70)	8 (30)	27 (100)

* Data are given as number (percentage). All percentages are based on n = 27.
† Eliminated from final analyses

Results

Of 146 surveys, 33 (22.6 %) were returned. The surveys returned by 5 subjects were unusable. Of these, 4 subjects were unable to supply the requested information due to working as a relief anesthetist in multiple facilities. The fifth subject indicated that the information was too confidential to be provided. Therefore, 28 surveys were used in the data analysis. Data were collapsed for several of the analyses due to the small sample. Some categories had missing data, because all respondents did not answer all survey questions.

Rural communities were classified as *small towns* (<10,000 people) or *large towns* (10,000-50,000 people). Facilities were categorized as *small hospitals* (<100 beds) or *large hospitals* (100 beds or more). Small hospitals were more likely to be located in communities of fewer than 10,000 people ($P = .006$). Towns with more than 10,000 people were equally likely to have small or large hospitals.

Demographic data on individual respondents were not solicited because the hospital was the level of analysis. The demographics of the communities and hospitals where the respondents worked are presented in Table 1. The majority of respondents (23/28 [82%]) worked in facilities located in communities with a population smaller than 50,000, and 11 (41%) of 27

Table 2. Mean number of surgical specialties, surgeons, and procedures for rural hospitals and communities

Community size	No. of beds	Specialties (n = 19)	Surgeons (n = 22)	Procedures (n =18)
< 10,000	< 100	6.9	12.30	710.27
10,000-50,000	< 100	5.4	11.33	921.25
	> 100	10.5*	36.67†	4,760.70‡

* $P < .05$
† $P < .01$
‡ $P < .001$

Table 3. Distribution of anesthesia providers by community and facility size*

		Nurse anesthetists			
Community size	No. of beds	Independent	Medically directed	Anesthesiologists	Other†
< 10,000	< 100	11‡	0	1	2
10,000-50,000	< 100	6	5	6‡	0
	> 100	0	3	3	1
Total		17	8	10	3

* N = 23. The number of responses is greater than N because more than 1 response could apply.
† Includes nurse anesthesia students, anesthesia assistants, dentists, nonanesthesiologist physicians, interns, and residents. Anesthesia residents were not present at any facility.
‡ $P < .01$.

respondents worked in communities of fewer than 10,000. The most frequently reported institution size was smaller than 100 beds (19/27 [70%]). Only 8 subjects (30%) indicated working in facilities of 100 beds or larger. Two (7%) of 27 respondents worked in office or ambulatory surgery settings and were included as working in facilities of less than 100 beds. Four respondents (15%) worked in urban locations (> 50,000 people) and were excluded from further analyses. Subsequent analyses were performed for the responses from 24 subjects.

Characteristics of rural surgical services

The number of surgeons in the facility and the volume of surgical cases varied with the size of the community and the hospital (Table 2). The total number of surgeons was significantly greater in large rural communities ($P = .044$) and large facilities ($P = .0001$). In addition, the number of surgical specialties in a facility was related to the size of the hospital but not to the size of the rural community. Hospitals with more than 100 beds were more likely to have a variety of surgical specialties than were smaller hospitals ($P = .003$). The surgical specialties most frequently identified in rural communities (in rank order) were general surgery, gynecology, ophthalmology, orthopedics, otolaryngology, and urology.

The volume of surgical procedures was significantly greater in larger facilities ($P = .0001$) and communities ($P = .028$). The average number of procedures performed annually in large facilities was 4,761 compared with 767 in small facilities. Hospitals in small towns were significantly less likely to perform 1,000 cases per year ($P = .016$). General surgery, gynecology, otolaryngology, urology, and orthopedic procedures were the most common types of surgeries performed in rural hospitals when ranked by frequency of occurrence. Cardiac, thoracic, and vascular surgical procedures were performed only in larger hospitals (>200 beds) or communities.

Characteristics of rural anesthesia departments

Because healthcare providers are in short supply in rural areas and general practitioners sometimes provide anesthesia services, respondents were asked to describe the individuals providing anesthesia services in their facilities and their employment patterns (Table 3). Nurse anesthetists and anesthesiologists were the most frequently reported individuals giving anesthesia in rural facilities. Only 3 (12%) of 24 respondents indicated that "other" anesthesia providers (nonanesthesiologist physicians, anesthesia assistants, nurse anesthesia students, or residents) worked in their facilities, and there was no difference in their presence based on community or facility size.

Table 4. Employment arrangements of anesthesia providers*

Community size	No. of beds	Facility	CRNA-only group	Anesthesiologist-CRNA group	Independent contractors
< 10,0000	< 100	7	1	0	2
10,000-50,000	< 100	2	1	2	3
	> 100	2	2	5	1
Total		11	4	7	6

* N = 23. The number of responses is greater than N because responses applied to all anesthesia providers in a facility.

Table 5. Number of anesthetic drugs available in 22 rural hospitals

	< 100 Beds		> 100 Beds	
	Mean (SD)	Range	Mean (SD)	Range
Adjunctive agents	5.5 (1.3)	1-6	5.8 (0.4)	5-6
Analgesics	6.2 (1.6)	3-9	7.0 (1.4)	5-9
Gaseous agents	5.6 (1.7)	1-8	6.7 (1.2)	5-8
Local anesthetics	3.8 (1.5)	1-7	6.2 (1.3)*	4-8
Neuromuscular blockers	4.8 (1.6)	3-8	7.3 (1.4)*	6-9
Sedatives, hypnotics, tranquilizers	6.3 (1.5)	2-9	7.5 (1.2)	6-9
Total	32.3 (6.9)	14-42	40.5 (3.8)†	36-46

* $P < .05$
† $P < .01$

The practice patterns of rural nurse anesthetists varied with facility and community size. Nurse anesthetists were categorized as medically directed or nonmedically directed (independent). Of 23 respondents, 8 were medically directed and 17 practiced independently (2 respondents indicated working in both capacities depending on the hours of service). Independent nurse anesthetists were more likely to work in small rural towns ($P = .001$) and in small hospitals ($P = .004$) than medically directed CRNAs. None of the medically directed CRNAs worked in small rural communities. Anesthesiologists were more likely to work in large rural towns ($P = .001$) and were less likely to work in small hospitals ($P = .001$).

Respondents were asked to describe the employment arrangements of anesthesia providers in their facility (Table 4). Employment arrangements were defined as employed by a facility (hospital or office; n = 11), a group practice (n = 11), a locum tenens agency (n = 0), a health maintenance organization (n = 0), or working as an independent contractor (n = 6). Group employment was subdivided into a CRNA-only group (n = 4) or a combined CRNA and anesthesiologist group (n = 7). Six institutions employed independent contractors. Some respondents indicated that providers worked in more than one employment setting.

Employment patterns of rural anesthesia providers varied with community and facility size. Anesthesia providers who were not independent contractors were as likely to be employed by a hospital as by a group. CRNAs as a whole were equally likely to be employed by a hospital or a group; however, more independent CRNAs than medically directed CRNAs were employed by a hospital. Employment of anesthesia providers by a physician group was more likely to occur in large towns ($P = .002$) and large hospitals ($P = .001$). While not statistically significant, independent contractors more frequently worked in small facilities.

Availability of anesthetic drugs and equipment

The availability of commonly used and currently available anesthetic drugs and monitoring devices was assessed (Table 5). Anesthetic drugs were categorized as analgesics, gaseous agents, local anesthetics, neuromuscular blocking drugs, sedative-hypnotic drugs, or adjunctive drugs. The total number of drugs and specific agents available varied with the size of an institution. Large facilities had a greater mean number of anesthetic drugs available than did small facilities ($P = .012$). When examined by category, large facilities stocked more local anesthetic agents and neuromus-

cular blocking drugs than did small hospitals (P = .003). Cisatracurium, rapacuronium, D-tubocurarine, mepivacaine, and procaine were available less frequently in small facilities. The differences were significant only for mepivacaine and procaine (P = .001).

The availability of anesthetic monitoring devices and the frequency of use was assessed (Tables 6 and 7). Subjects were asked whether a device was available, and if it was, subjects were asked whether the monitor was used "Always," "Sometimes," or "Never." Consistent with standards of practice, an electrocardiogram, noninvasive blood pressure cuff, oxygen analyzer, and pulse oximeter were available and used by all respondents on all cases. Overall, more monitoring devices were available to anesthetists in larger communities (P = .005) and larger facilities (P = .033). Devices that were more likely to be available in large rural communities were agent analyzers (P = .0195) and Doppler devices (P = .0400).

There was no difference in the availability of invasive monitoring devices based on facility size. Of the rural institutions, 19/21 (90%) had the ability to monitor central venous pressure, and 17/20 (85%) could monitor intra-arterial blood pressure, but only 13/19 (68%) had the ability to monitor pulmonary artery pressures. Highly sophisticated monitors were used rarely in small rural facilities. Pulmonary artery catheters (P = .019), Doppler devices (P = .036), evoked potential monitors (P = .009), and intracranial pressure monitors (P = .009) were notably less likely to be used in small facilities.

Anesthesia services available in rural hospitals

The availability of common anesthesia services was assessed. All subjects except those working in ambulatory or office settings reported that their institutions offered 24-hour operating room and obstetrical services. All respondents took operating room call and 18 (86%) of 22 also took obstetrical call. Anesthesiologists were significantly less likely to take operating room call in small rural communities (P = .006) and small hospitals (P = .001). The majority (17/19 [89%]) of rural CRNAs took call from home rather than "in-house" call. The average response time for both surgery and obstetrics was 20 minutes for in-house call or call taken from home.

Anesthetic techniques used in the provision of obstetrical services were examined. The techniques included spinal, epidural for labor and cesarean section, combined spinal and epidural anesthesia, general anesthesia, and the administration of intrathecal opioids. All techniques except combined spinal and epidural anesthesia were used in the majority of communities and facilities. Epidural analgesia was offered for labor in 17 (77%) of 22 facilities, while combined spinal and epidural anesthesia was provided by 9/22 (41%). No significant differences were found in the types of services offered in large and small communities or facilities.

The availability of a pain management service (Table 8) was not related significantly to the size of a community or facility or to supervision of a nurse anesthetist by an anesthesiologist. Pain management techniques did not differ among settings except that facet blocks were performed significantly less often by independent nurse anesthetists (P = .019) and CRNAs practicing in small hospitals (P = .008).

Rural CRNAs provided ancillary services outside the operating room in addition to traditional anesthesia duties (Table 9). Intubation (19/21 [90%]) and peripheral intravenous insertion (18/21 [86%]) were the most frequently provided services, followed closely by lumbar puncture (15/21 [71%]). Approximately half of the respondents were involved in education (11/21 [52%]) or administration (10/21 [48%]) in their facilities. Arterial lines were inserted by 10 (48%) of 21 outside the operating room, but only 7 (33%) of 21 inserted central lines in nonanesthetizing locations. With the exception of arterial line insertion, provision of services outside the operating room was not related to the size of the hospital, community, or the presence of an anesthesiologist. CRNAs in small rural communities were significantly less likely to insert arterial lines outside of the operating room (P = .050). Independent and medically directed CRNAs did not differ in the types of procedures or services performed outside of the operating room.

Discussion

The results of the present study support the existing literature and statements by the AANA that nurse anesthetists are the predominant providers of anesthesia services in rural hospitals.[1,2,19] Non–medically directed (independent) nurse anesthetists were the most frequent anesthesia providers in small rural communities and hospitals. Anesthesiologists and other anesthesia providers such as students, residents, and anesthesia assistants seldom were found to practice in rural communities. The finding that anesthesiologists are more likely to work in large rural communities and large hospitals is consistent with previous work and the distribution of other specialty physicians.[2]

The array of surgical services reported in this study was consistent with the national picture of rural hospitals and providers.[4-6,14,20] The number of surgical

Table 6. Availability and use of monitoring devices in 22 rural facilities by bed size*

Monitoring device	Always or sometimes		Never	
	< 100 beds	> 100 beds	< 100 beds	> 100 beds
Standard monitors†	16	5		
Respiratory gases‡	15	5		
Airway pressure	15	5		
Precordial	15	5		
Temperature	15	5	1	
Esophageal	13	5	2	
External fetal heart	13	5	1	
Internal fetal heart	13	4	1	1
Invasive blood pressure	10	5	4	
Central venous pressure	10	4	5	1
Agent analyzer	10	5	5	
Pulmonary artery catheter	5	5	8§	
Cardiac output	4	4	9	1
Doppler	5	5	8§	
Transesophageal echocardiography	1		12	5
Intracranial pressure	2	4	11‖	1
Evoked potentials	2	4	11‖	1

* The number of responses is less than N due to missing data.
† Electrocardiogram, noninvasive blood pressure, oxygen analyzer, and pulse oximeter
‡ Respiratory gas monitors, including oxygen analyzer and capnography
§ $P < .02$
‖ $P < .002$

Table 7. Availability and use of monitors by community size*

Monitoring device	Always or sometimes		Never	
	< 10,000	10,000-50,000	< 10,000	10,000-50,000
Standard monitors†	11	10		
Precordial	11	9		
Capnography	11	9		
Airway pressure	11	9		
Temperature	10	10	1	0
External fetal heart	10	8	0	1
Internal fetal heart	10	7	0	2
Esophageal	9	9		0
Central venous pressure	7	7	4	2
Invasive blood pressure	6	9	4	0
Agent analyzer	6	9	5‡	0
Pulmonary artery catheter	6	0	4	2
Doppler	3	7	7‡	1
Intracranial pressure	1	4	9	4
Evoked potentials	1	4	9	4
Transesophageal echocardiography	1	0	9	8

* The number of responses is less than N due to missing data.
† Electrocardiogram, noninvasive blood pressure, oxygen analyzer, and pulse oximeter
‡ $P < .02$

Table 8. Rural nurse anesthetists providing pain management services*

Technique	No. (%)
Pain service	13 (62)
Epidural steroid injection	15 (71)
Postoperative epidural narcotics	13 (62)
Intrathecal narcotics	12 (57)
Patient controlled analgesia	11 (52)
Trigger point injection	9 (43)
Stellate ganglion block	4 (19)
Facet block	2 (10)

* N = 21

Table 9. Rural nurse anesthetists providing service outside the operating room*

Service	No. (%)
Intubation	19 (90)
Peripheral intravenous placement	18 (86)
Lumbar puncture	15 (71)
Education	11 (52)
Arterial line placement	10 (48)
Administration	10 (48)
Central line placement	7 (21)
Other service	3 (14)

* N = 21

specialties, the total number of surgeons on staff, and the volume of surgical procedures were greater in larger rural facilities and communities. This finding is not surprising because larger communities have the volume of patients necessary to support a larger number of surgeons, who in turn generate a larger volume of surgical procedures. Cardiac, vascular, and thoracic surgeons are almost always located in larger hospitals. This result is consistent with the fact that larger facilities have the technological support necessary for these complex procedures and more highly trained personnel who are capable of providing preoperative and postoperative care.

The employment patterns of rural nurse anesthetists in the present study were similar to those of the profession as a whole. Nationally, 33% of CRNAs work for hospitals, 37% are employed by a physician-controlled group, and 20% are self-employed or work for a CRNA group.[3] In this small sample, rural nurse anesthetists were equally likely to be employed by a hospital or other facility as by a group. However, CRNAs who were self-employed (independent contractors) were more likely to work in smaller facilities. CRNAs may be more likely to be self-employed if the hospital is unwilling to employ the CRNA, if the prevailing salary at that facility is low, or if the surgical caseload is not adequate to support a full-time anesthesia provider. The presence of more independent contractors in smaller facilities also seems consistent with the need for CRNAs in small facilities to use independent contractors to obtain time off.

Independent CRNAs in rural areas were more likely to be hospital employees than were medically directed CRNAs. This situation may reflect the volume of surgical procedures performed by the facility and third-party reimbursement policies. Rural CRNAs may require financial support from a hospital if the surgical caseload or third-party reimbursement is insufficient to provide an adequate income. Medicare Part A provides reimbursement at cost for anesthesia services to facilities that perform fewer than 500 surgical procedures per year.[21] (The Center for Medicare and Medicaid Services increased the number to 800 cases in 2002.) In this case, the hospital is more likely to employ the CRNA because the facility can "pass through" the cost of employing the CRNA.

The present study identified that rural anesthetists have a wide range of anesthetic agents and adjuvant drugs available. The overall availability of anesthetic drugs was limited only by the size of the facility. Given financial and volume constraints, it is not surprising that small rural hospitals limit their formularies, particularly when the pharmacological profiles of drugs overlap. It is interesting that differences in anesthetic drug availability existed only in the categories of neuromuscular blocking and local anesthetic agents when equally expensive inhalation agents, antiemetics, and narcotics were available. Mepivacaine and procaine, 2 local anesthetics reported significantly less often in small facilities in this study, are older and less expensive agents. Obviously fewer agents are required if fewer providers work in a facility or if little regional anesthesia is performed. Finally, longer acting neuromuscular blocking drugs may not be required in smaller facilities because procedures and anesthetics are often of shorter duration.

The present study's findings demonstrate that the availability of monitoring devices to rural anesthetists was related significantly to the size of the hospital and community. While standard monitors were available

and used on all cases, sophisticated invasive monitoring devices were less likely to be available in small hospitals and, even when available, were less likely to be used. Since rural facilities seldom perform complex surgical procedures requiring such monitoring, it is understandable that Doppler devices, pulmonary artery catheters, transesophageal echocardiography, intracranial pressure monitors, and evoked potential monitors would not be required. Agent analyzers, however, are not that sophisticated, so the relationship of community size to the lack of availability of agent analyzers is unclear.

Being available for emergencies, or "taking call," is a major responsibility for anesthesia providers. Not surprisingly, all of the hospitals in the present study provided round-the-clock anesthesia coverage for obstetrical and surgical emergencies, with the majority of rural CRNAs taking call from home rather than in-house. The lower volume of surgical and obstetrical procedures in small rural facilities makes it unnecessary for anesthesia providers to remain available in the hospital 24 hours a day. Anesthesiologists were less likely to take call in small rural communities and facilities. This finding is not unexpected because fewer anesthesiologists and more CRNAs work in rural areas. The low response rate prevented examination of the data to determine whether there was a difference in the frequency and type of provider taking call in facilities with both anesthesiologists and CRNAs.

A surprising 17 (77%) of 22 facilities in the present study provided epidural analgesia for labor. One newer technique, combined spinal and epidural analgesia, was less likely to be offered, perhaps because providers were less familiar with the technique. Anesthesia providers in some facilities may offer general or spinal anesthesia for cesarean sections but may be unwilling to offer epidural analgesia for labor because the technique is time- and labor-intensive. As a result, small rural facilities with 1 or 2 anesthesia providers might be less likely to offer such services. Although the rural birth rate is lower than that of metropolitan areas, the provision of obstetrical services remains an important component of a hospital's business and an anesthesia provider's services in rural communities.

Pain management services, as a separate entity from postoperative pain management, is not offered commonly by CRNAs.[22,23] However, the majority of rural nurse anesthetists in the present study provided a pain service. The pain management techniques performed most frequently by rural CRNAs were an extension of basic regional anesthetic techniques that were learned during training. Trigger point injections were administered by 9 (43%) of 21 respondents, but few rural CRNAs reported performing stellate ganglion or facet blocks. The need for pain management services in rural communities suggests that nurse anesthesia programs should consider expanding their curricula in these areas. Nurse anesthetists also must educate their rural physician colleagues about the expertise of CRNAs in pain management and encourage the use of CRNAs to provide pain management services to their patients.

Because admission to a nurse anesthesia program requires several years of nursing experience, rural CRNAs have the background to provide a variety of nonanesthesia services. About half of the respondents were involved in educational or administrative roles outside the operating room. However, nurse anesthesia students who opt to practice in rural areas may be unaware that these duties are part of their future clinical role. Nurse anesthesia programs must emphasize that the CRNA's professional role extends beyond the administration of anesthesia and include exposure to these aspects in their curricula.

The technical skills of CRNAs are frequently requested outside of the operating room. The range of anesthetic services supplied in nonanesthetic locations closely mirrored those that CRNAs perform in the operating room: intubation, intravenous needle or catheter insertion, and lumbar puncture. The demand for these technical skills in rural facilities may be indicative of a shortage of other highly trained professionals or the limited proficiency of other providers. Interestingly, although arterial line insertion outside of the operating room was performed by approximately half of rural CRNAs, central line insertion was performed by only one third. The experience of one of us (E.M.S.) in a 48-bed rural facility is that central line insertion frequently is requested for venous access. However, the need for central line insertion may reflect the types of surgical procedures performed at a facility, a limited need for central venous access, or the possibility that physicians and surgeons are inserting their own central lines.

The present study has several limitations. The low response rate and limited data obtained for some questions preclude making generalizations from the results. Sample selection and questionnaire construction may have affected the response rate. The length of the questionnaire may have discouraged some subjects. The assumption was made that subjects living in rural areas also worked in those areas, but the place of residence and employment are not always related. Individuals living in rural areas often commute to urban areas for work.[24]

Implications

The present study has implications for nurse anesthesia

education, workforce planning, and future research. Nurse anesthesia educators can take comfort that the broad-based nurse anesthesia curriculum that includes instruction and practice with a wide variety of agents and anesthetic techniques is adequate to prepare nurse anesthetists for rural practice. Since rural CRNAs incorporate a variety of regional anesthesia techniques in their practice, the recent decision of the Council on Accreditation of Nurse Anesthesia Educational Programs to require regional anesthesia administration in curricula will be beneficial to future graduates who intend to locate in rural areas.[25] The Council also should evaluate minimal requirements for central line insertion because rural providers frequently are asked to insert these devices for venous access. Educational programs should consider including instruction in the areas of administration and teaching because rural CRNAs provide these services in addition to their normal operating room responsibilities.

Anesthesia workforce planning must recognize the vital role of CRNAs in the provision of anesthesia services in rural communities. Because it seems unlikely that anesthesiologist practice patterns will change[2,26] and because the nurse anesthesia workforce is aging and a shortage of anesthesia providers is forecast,[27] a multipronged approach is needed to address the preparation of rural providers. Educational programs, particularly those in states with a large rural population, must make a concerted effort to prepare graduates for rural practice. Programs should identify rural preceptors and incorporate rural clinical rotations to expose students to rural practice. For example, the Medical College of Georgia Nursing Anesthesia Program (Augusta) requires students to complete a 2-month rural practicum and a didactic course related to rural health and anesthesia issues. Twenty-three percent of the program's graduates are employed in rural communities in Georgia.

An urgent need exists for further research about the characteristics of individuals who practice in rural areas and the factors that lead CRNAs to select rural practice. Research is particularly needed regarding case mix, patient outcomes, and patient satisfaction with anesthesia services in rural areas. The present study revealed that rural nurse anesthetists seem to have access to the same anesthetic agents and monitoring devices as do urban CRNAs, although rural CRNAs are more likely to administer anesthesia for less complicated surgical procedures. This finding does not negate the difficulty of anesthetic administration for rural patients who are often older, have more chronic conditions, and view their health as poorer compared with urban patients.[28,29] Future research should attempt to identify whether there are differences in the severity of illness of rural and urban patients and compare outcomes of rural and urban anesthesia practices.

REFERENCES

1. Dunbar PJ, Mayer JD, Fordyce MA, et al. Availability of anesthesia personnel in rural Washington and Montana. *Anesthesiology.* 1998; 88:800-808.
2. Orkin FK. Rural realities. *Anesthesiology.* 1998;88:568-571.
3. Garde JF. Report of the Executive Director. *AANA NewsBulletin.* December 2000;54(11):11-14.
4. Callaghan JP. A twenty-five year survey of a solo practice in rural surgical care. *J Am Coll Surg.* 1994;178:459-465.
5. Landercasper J, Bintz M, Cogbill TH, et al. Spectrum of general surgery in rural America. *Arch Surg.* 1997;132:494-497.
6. Herring DD. General surgeons in the small towns of Georgia. A*m Surg.* 1986;52:341-345.
7. Samuels ME, Shi L. Trends in medicine. In: *Physician Recruitment and Retention: A Guide for Rural Medical Group Practice.* Englewood, Colo: Medical Group Management Press; 1993:11-23.
8. Ricketts TC. Rural communities and rural hospitals. *J Rural Health.* 1999;15(2):168-169.
9. Garde JF. Report of the Executive Director. *AANA NewsBulletin.* November 1998;52(10):13-16.
10. Szigeti E, Largent, RN, Eberhardt, BJ. An exploratory study of the correlates of intent to quit among Certified Registered Nurse Anesthetists in North Dakota. *J Rural Health.* 1990;6:317-327.
11. Doeksen GA, Loewen RA, Strawn DA. A rural hospital's impact on a community's economic health. *J Rural Health.* 1990;6:53-64.
12. Weisgrau S, McDowell SH. *The Economic Impact of National Health Service Corps Physicians on Rural Communities.* Rockville, Md: US Department of Health and Human Services; 2002.
13. O'Shaughnessy J, Clark L, Dye N, et al. Success factors for the future survival of rural hospitals. *Best Pract Benchmarking Healthcare.* 1997;2:1-19.
14. Stevick JA, Mullis EN, Connally SR, Dalton ML, Sealy WC. Perspectives of rural surgical practice in Georgia. *Am Surg.* 1994;60: 703-706.
15. Alexander JW. Measuring organizational structure on nursing units. Paper presented at: Research 86; May 15, 1986; Columbia, SC.
16. Leifer R, Huber GP. Relations among perceived environmental uncertainty, organizational structure, and boundary spanning behavior. *Adm Sci Q.* 1977;22:235-247.
17. Alexander JW, Randolph WA. The fit between technology and structure as a predictor of performance in nursing subunits. *Acad Manage J.* 1985;28:844-859.
18. Cumbey DA, Alexander JW. The relationship of job satisfaction with organizational variables in public health nursing. *J Nurs Adm.* 1998;28:39-46.
19. Rosenbach ML, Cromwell J. A profile of anesthesia practice patterns. *Health Aff (Millwood).* Fall 1988;7:118-131.
20. Ritchie WP Jr, Rhodes RS, Biester TW. Work loads and practice patterns of general surgeons in the United States, 1995-1997: a report from the American Board of Surgery. *Ann Surg.* 1999;230: 533-543.
21. Health Care Financing Administration, US Department of Health and Human Services. Title 42: Public health. Office of the Federal Register, National Archives and Records Administration, US Government Printing Office Web site. October 1, 2000. Available at: http://www.access.gpo.gov/nara/cfr/waisidx_00/42cfr412_00.html. Accessed July 26, 2001.
22. Heindel L. Acute pain management clinical practice guideline: implications for nurse anesthetists. *CRNA Clin Forum Nurse Anesthetists.* 1997;8:94-100.

23. Loach JL. Clinical differentiation of the patient in pain: an introductory guideline for CRNAs. *CRNA Clin Forum Nurse Anesthetists*. 1997;8:105-109.

24. Aldrich L, Beale C, Kassel K. Commuting and the economic functions of small towns and places. *Rural Dev Perspect*. Available at: http://www.ers.usda.gov/publications/rdp/rdp697/rdp697e.pdf. Accessed July 31, 2001.

25. Council on Accreditation of Nurse Anesthesia Educational Programs. *Standards for Nurse Anesthesia Educational Programs*. Park Ridge, Ill: Council on Accreditation of Nurse Anesthesia Educational Programs; 1999.

26. Orkin FK. Work force planning for anesthesia care. *Int Anesthesiol Clin*. 1995;33:69-101.

27. Rosenbach ML, Cromwell J, Pope GC, Butrica B, Pitcher JD. Report of the National Commission on Nurse Anesthesia Education. Study of nurse anesthesia manpower needs. *AANA J*. 1991;59:233-240.

28. Ricketts TC. Health care professionals in rural America. In: Beaulieu JE, Berry, DE, eds. *Rural Health Services: A Management Perspective*. Ann Arbor, Mich: Health Administration Press; 1994:85-110.

29. Hirsch S. Facts about the rural population of the United States. Rural Information Center Health Service; May 2001. Available at: http://www.nal.usda.gov/ric/richs/stats.htm. Accessed July 31, 2001.

AUTHORS

Elizabeth Monti Seibert, CRNA, MSN, is associate professor and director of Clinical Education, Virginia Commonwealth University, Department of Nurse Anesthesia, Richmond, Va.

Judith Alexander, RN, PhD, is Associate Professor, College of Nursing, University of South Carolina, Columbia, SC.

Alfred E. Lupien, CRNA, PhD, is associate professor and chairman, Department of Nursing Anesthesia, Medical College of Georgia, Augusta, Ga.