


ORIGINAL ARTICLE

The Surgical and Anesthesia Workforce and Provision of Surgical Services in Rural Communities: A Mixed-Methods Examination

Catherine Cohen, PhD, RN ¹; Matthew Baird, PhD;² Nirabh Koirola, BS;² Ryan Kandrack, BS;³ & Grant Martsof, PhD, MPH, RN, FAAN^{2,4}

¹ RAND Corporation, Santa Monica, California

² RAND Corporation, Pittsburgh, Pennsylvania

³ Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina

⁴ Department of Acute and Tertiary Care, University of Pittsburgh School of Nursing, Pittsburgh, Pennsylvania

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For further information, contact: Catherine Cohen, PhD, RN, RAND Corporation, 1776 Main Street, Santa Monica, CA 90401; e-mail: ccohen@rand.org.

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Abstract

Purpose: Rural-urban disparities in the surgical and anesthesia workforce exist. This mixed-methods study describes the distribution of the surgical and anesthesia workforce and qualitatively explores how such workforce and other factors influence rural hospitals' provision of surgical services.

Methods: We calculated provider counts by county from the Area Health Resource File. Using American Hospital Association survey data, we sampled rural hospitals, stratified by critical access status and state policies. We conducted qualitative semistructured interviews with administrators at 16 hospitals and performed directed content analysis of factors influencing surgical services provision at rural hospitals.

Findings: Within rural counties, 55.1% of counties had no surgeon, 81.2% had no anesthesiologist, and 58.1% had no Certified Registered Nurse Anesthetist (CRNA). Administrators reported that rural hospitals struggled to provide many surgical services given lack of subspecialty surgeons and adequate postsurgical care. Rural hospitals likely struggle to generate volumes necessary to support safe and profitable subspecialty surgery programs. Anesthesia services were not reported as a current limitation given that CRNAs in particular had strong, diverse skills sets and many hospitals allowed high CRNA autonomy. However, meeting anesthesia needs for emergency surgeries and 24-hour obstetrics posed significant challenges.

Conclusions: While rural hospitals reported meeting community needs for elective and noncomplex surgeries, rural hospitals continued to face significant challenges providing subspecialty surgeries, emergency surgeries, and 24-hour obstetrical services.

Key words anesthesiologists, health workforce, nurse anesthetists, rural health services, rural hospitals.

Ensuring access to high-quality surgeries is essential to good health outcomes. However, policymakers and health services researchers are increasingly concerned about access to surgeries in rural communities.¹⁻³ Shortages in the supply of the surgical and anesthesia workforce across the United States are likely to be an important determinant of access to surgical services in rural

communities. Recent studies have found that not only is there a national shortage of general surgeons across the United States, but also that the shortage is the greatest in rural areas.^{4,5} There are especially few subspecialty surgeons in rural communities,⁶ and rural patients travel less for hospital services when surgeon subspecialists travel to rural communities to provide surgeries.⁷ In addition to

surgeons, surgeries require the presence of an anesthesia provider including anesthesiologists and Certified Registered Nurse Anesthetists (CRNAs). Studies also found significant geographic and regional variation in anesthesia provider supply,^{8,9} with lower supply in rural areas.⁹ This maldistribution represents local shortages of both types of anesthesia providers, varying by urbanicity and region.¹⁰

Limited surgical and anesthesia workforce may constrain hospital capacity to provide services in rural communities. Such shortages may lead to patients in rural areas forgoing or delaying surgeries, which could lead to worse surgical outcomes for rural residents.¹¹⁻¹⁴ Surgery provision in rural communities is also critical to the financial well-being of rural hospitals.¹ In the past decade, rural hospital closures have grown.² Surgical procedures are among the most profitable services for hospitals. If rural hospitals cannot provide surgical services, their financial viability may be threatened, increasing risk of closure.

Understanding factors that prevent access to timely, high-quality surgical services to residents in rural areas is necessary to help address rural communities' health care needs and secure rural hospitals' financial viability. Despite observed rural-urban disparities in the surgical and anesthesia workforce, previous studies have not specifically explored qualitatively how the distribution of this workforce impacts access to surgical services. In this study, using a mixed-method approach, we provide the most up-to-date description of the national surgical and anesthesia workforce in rural communities by providing per capita counts of surgeons and anesthesia providers. We also conducted interviews with 16 rural hospitals to describe how the surgery and anesthesia workforce and other key factors are viewed as barriers and facilitators to delivery of surgical services in rural communities. We sought to determine, from the perspectives of hospital representatives, the impact of hospital and state-level policies on practice, rationale for anesthesia team composition and hospital policies, challenges to recruiting and retaining surgical workforce providers, and any other factors affecting surgical access in rural communities.

Methods

We used a descriptive mixed-method design using the following data sources and methods. All processes were approved by RAND's Human Subjects Protection Committee.

Quantitative Approach

We used Area Health Resource File (AHRF) data for our quantitative analysis of the distribution of the surgical

and anesthesia workforce. These data are publicly available at the county level. Through AHRF, we identified rural counties using Rural-Urban Continuum (RUCC) codes that were not metropolitan adjacent, RUCC codes 5 and 7-9. The variables of interest for this study were counts of surgical or anesthesia providers per 100,000 people within each county across the United States in 2017. We created alternate estimates by restricting our analysis to counties with at least 1 general short-term acute hospital as these are the counties that could have capacity for surgeons and anesthesia providers. We first calculated counts separately for general, specialty (nongeneral), and total surgeons. Then, we calculated counts of anesthesiologists, CRNAs, and total anesthesia providers. Finally, we compared rural and nonrural counties using basic descriptive statistics. The differences between rural and nonrural estimates were tested using *t* tests and chi-squared tests depending on the nature of the data.

Qualitative Approach

We were interested in understanding the impact of state scope of practice (SOP) policies for CRNAs on surgery access. State SOP laws regulate the extent to which CRNAs can deliver services without physician supervision. We were also interested in conditions of participation in Medicare for health care facilities requiring that CRNAs be supervised by either an operating physician or have an immediately available anesthesiologist on premise. State governors have been allowed to "opt-out" of Medicare's conditions of participation requirements since 2001; 17 states have done so as of 2018.¹⁵ The few previous efforts to discern the effects of these policies through quantitative data alone have not established a clear impact on access or utilization.¹⁵⁻¹⁸

Sample Identification

We again targeted hospitals in rural counties (RUCC codes 5 and 7-9) to be consistent with the quantitative analysis, but we also applied additional sampling approaches to maximize the potential of reaching data saturation and ensuring a diversity of respondents. We cross-referenced the American Hospital Association (AHA) annual survey data with the AHRF to identify rural hospitals and excluded those with services limited to a nonsurgical specialty (eg, psychiatric hospitals). Then, we used both stratified random and convenience sampling approaches to identify rural hospitals.

We sampled hospitals based on (1) hospitals' critical access status (yes/no), (2) state opt-out policy (yes/no), and (3) state CRNA SOP (full SOP/supervision/collaboration). We categorized hospitals meeting our sampling criteria by

these 3 dimensions. As there were no states that both require supervision of CRNAs and have an opt-out policy, this resulted in 10 strata (see Appendix, available online only). We randomly selected 3 hospitals for recruitment from within each of these strata to target a total of 30 rural hospitals. Through Internet searches and phone calls as needed, we confirmed that each of the selected hospitals offered surgical services prior to recruitment.

We supplemented our stratified random sample with a limited convenience sample of hospital administrators also working in rural hospitals whose contact information was provided by the American Association of Nurse Anesthetists (AANA, $n = 9$).

Recruitment and Data Collection

Recruitment and data collection took place May–August 2018. We identified 1 representative to interview per selected hospital and recruited these interviewees. We sought to identify potential interviewees with titles such as head of surgical services, operating room (OR) director, chief operating officer, or chief medical officer who may be most knowledgeable about surgical services.

We presented each interviewee with information about the study and an informed consent document. Each verbally provided consent prior to their interview. One of 2 experienced researchers conducted each interview via telephone following a semistructured discussion guide. Interviews were audio-recorded and transcribed verbatim.

Analysis

We used directed content analysis to identify key themes across the interviews.¹⁹ We developed a code book based on the content of the interview guide. The transcripts were each coded independently by 2 authors using these *a priori* codes, with discrepancies subsequently discussed to consensus. The authors then created and discussed memos and collaboratively drew key themes from the memos.

Findings

Quantitative Findings

As shown in Table 1, we found significant differences between rural and nonrural counties in the number of providers per capita in each provider category. There were more providers per capita in nonrural counties than rural counties. We found that approximately 64.3% of

rural counties had no general surgeons, 62.8% had no specialty surgeons, and 55.1% had no surgeons at all. Results were similar for anesthesia providers as more than 81.2% of rural counties had no anesthesiologist, roughly 58.1% had no CRNA, and 54.9% had no anesthesia provider at all. We also found that rural communities relied heavily on CRNAs as, on average, 81.1% of anesthesia providers across all rural counties were CRNAs. These estimates were similar in counties with at least 1 general short-term acute hospital.

Qualitative Findings

We identified 6,110 hospitals through the AHA survey, which we narrowed to 832 hospitals after excluding specialty facilities and those in nonrural counties. We then selected 103 hospitals for recruitment. Thirty-six of these hospitals were subsequently excluded for lacking a surgical department, having a change in ownership within the past year, or having a new or inexperienced individual in the relevant interviewee role(s). Of contacted hospitals, the participation rate was 24%. Reasons for nonparticipation included failure to identify a potential interviewee after 3 attempts, nonresponse of the potential interviewee(s) after 3 attempts, and refusal to participate at the department or hospital level.

Table 2 compares characteristics of those that participated in the interview ($n = 16$, 4 of which were from the convenience sample) and nonparticipating hospitals. The hospitals that participated in the interviews were diverse. The majority were owned by either government or nonprofit entities and were critical access. Approximately two-thirds of hospitals were in states that had not opted out of the Medicare condition for participation and over half were in states whose SOP required collaboration or supervision of a physician for CRNA practice. On average the hospitals had 78 beds, serviced 211 annual births, and performed 425 and 1,959 annual inpatient and outpatient surgeries, respectively. None of the differences between participating and nonparticipating hospitals were statistically significant.

Interview participants held various positions including OR manager/director, chief executive officer, director of anesthesia services, chief CRNA/CRNA supervisor, surgical services manager/director, OR nurse manager, and contracted-staff CRNA (Table 3). One OR director was also the director of the emergency room and same-day services and anesthesia services. Respondents had been working in the hospital, on average, for over a decade (range: 1–25 years) and had spent 6 years in their current positions (range: 1–20 years).

The primary takeaways from these interviews were that rural hospitals struggled to provide many

Table 1 Descriptive Statistics of Surgical and Anesthesia Workforce by County, 2017

	All Counties (n = 3,184)		Counties With a Short-Term General Hospital (n = 2,459)	
	Rural ^a (1,169) Mean (SD)	Nonrural (1,979) Mean (SD)	Rural ^a (n = 799) Mean (SD)	Nonrural (1,660) Mean (SD)
Counts of providers per 100,000 people				
General surgeons	4.2 (7.9)	6.9 (11.5)	5.6 (8.6)	7.9 (12.1)
Specialty surgeons	8.1 (15.3)	20.2 (29.1)	10.9 (17.2)	22.8 (30.1)
Anesthesiologists	2.1 (6.9)	6.6 (10.7)	2.6 (6.2)	7.3 (11.1)
CRNA	8.3 (14.3)	11.5 (20.7)	11.8 (15.9)	13.4 (22.0)
Counties without any providers by provider category	%	%	%	%
General surgeons	64.3	27.3	50.8	19.2
Specialty surgeons	62.8	23.9	52.2	17.3
Any surgeon	55.1	18.2	42.3	11.6
Anesthesiologists	81.2	38.6	74.7	32.8
CRNA	58.1	26.5	40.8	16.9
Any anesthesia provider	54.9	18.4	38.2	10.8
Proportions of providers:	% (SD) ^b	% (SD) ^b	% (SD) ^b	% (SD) ^b
Of surgeons that are general	38.6 (33.6)	30.3 (24.4)	40.4 (32.5)	30.4 (23.3)
Of anesthesia providers that are CRNAs	81.1 (30.1)	62.0 (33.3)	83.2 (27.1)	64.1 (31.5)

SD, standard deviation; CRNA, Certified Registered Nurse Anesthetist.

^aIncludes counties with rural-urban continuum codes 5 and 7-9.

^bAverage of county-level proportions.

Note: All differences between rural and nonrural counties significant at $P < .001$ except for counts of CRNAs in counties with a short-term general hospital, which is significant at $P < .05$.

surgeries due to lack of access to subspecialty surgeons, lack of postsurgical care needed for specialty surgeries, and general lack of infrastructure to expand offerings. Rural hospitals also were unlikely to be able to build critical volume to support expanded specialty surgeries. Anesthesia providers were not viewed as the primary current limitation in providing more surgical services and anesthesia is generally provided by CRNAs with strong and diverse skill sets. However, due to reliance on locum tenens and CRNA contractors as well as the pressures of providing 24/7 emergency and obstetrical care, the CRNA workforce could be described as “tenuous,” especially in areas with hospitals that hoped to expand services. We outline these key themes in Figure 1 and describe them in detail below.

Rural Hospitals Struggle to Provide Many Surgeries

Many interviewees reported that their hospitals were unable to provide some surgical services that they would otherwise like to provide. These services varied across

hospitals but generally focused on surgical subspecialties (eg, urology, orthopedics). The interviewees believed that hospitals' inability to provide these services meant patients either had needed to drive long distances to other facilities or possibly had forgone surgeries altogether. One respondent stated that:

It forces [patients] to leave the market, 30 miles in one of the directions. So, transportation can be a barrier. So, I think it could have a longer-term effect; maybe there's things and services that they need that they let go that just, you know, lead to a greater problem.

That said, interviewees noted that individuals in rural communities were used to making substantial drives into city centers for daily activities, such that travel for medical care was seen as a normal part of life:

People who go to a doctor regularly and are told that they need to have a urologic procedure then [they just do it]. I mean we go to the next town over every other weekend, because that's what you do, right? When you're in an [agricultural] community.

Table 2 Characteristics of Participating and Nonparticipating Rural Hospitals^a

	Participating hospitals (n = 16)			Nonparticipating hospitals (n = 87)			
Sampling		n			n		
Convenience sample		4			5		
Random selection		12			82		
State policy	%	n		%	n		P
Opt-out	37.5%	6		31.0%	27		.61
Scope of practice							.45 ^b
Full	43.8%	7		32.1%	28		—
Supervision	31.3%	5		26.4%	23		—
Collaboration	25.0%	4		41.4%	36		—
Hospital characteristic							
Critical access designation	62.5%	10		51.7%	45		.43
Sole community provider	18.8%	3		13.8%	12		.61
Ownership							.06 ^b
Government	51.7%	4		25.0%	45		—
For profit	5.8%	3		18.8%	5		—
Nonprofit	42.5%	9		56.3%	37		—
	Median	Mean	SD	Median	Mean	SD	P
Bed count	43	78.1	66.6	32	53.4	52.1	.10
Births in hospital annually	144	210.9	211.9	30	157	246.8	.41
Surgical operations, inpatient	280	425.2	460.8	106	385.3	820.6	.85
Surgical operations, outpatient	1,625	1958.9	1928.4	663	1319.4	2052.3	.25

SD, standard deviation.

^aSample includes hospitals with operating rooms in rural-urban continuum codes 5 and 7-9, excluding nonsurgical specialty hospitals; sample stratified to target 50% critical access, and diverse by each state delivery model (combination of opt-out and supervision, collaboration, and full scope of practice regulations).

^bCalculated by chi-square.

Table 3 Characteristics of Interviewees, Administrators in Rural Hospitals (N = 16)

Interviewee characteristics	Mean	SD
Years of experience in role	6.5	6.7
Years working in hospital	13.0	8.4
Job title	Proportion	N
Operating room manager/director	25.0%	4
Chief executive officer	18.8%	3
Director of anesthesia services	18.8%	3
Chief CRNA/CRNA supervisor	12.5%	2
Surgical services manager/director	12.5%	2
Operating room nurse manager	6.3%	1
Contract CRNA	6.3%	1

SD, standard deviation; CRNA, Certified Registered Nurse Anesthetist.

Access to Subspecialty Surgeons Are the Central Challenge Facing Rural Hospitals

The most common challenge to expanding hospitals' surgical programs was the availability of surgeons, particularly subspecialty surgeons. Interviewees noted that recruitment struggles in a rural community stemmed from limited cultural amenities in the area, extensive

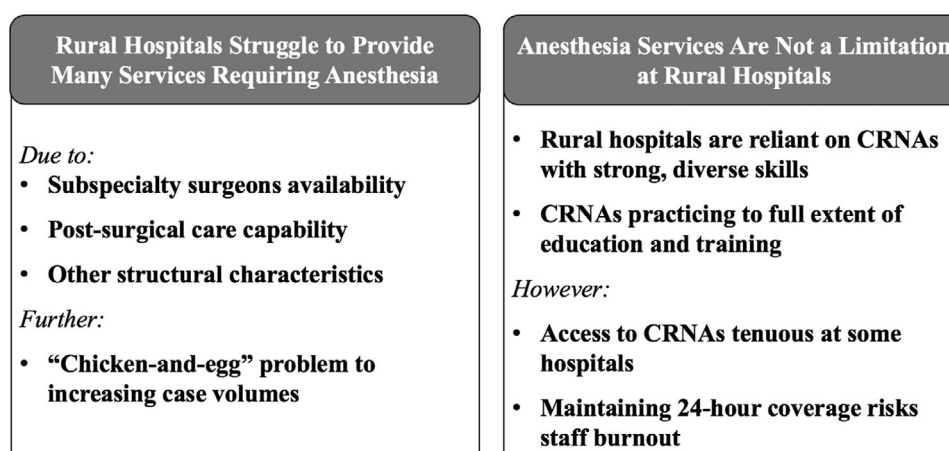
call frequency of the position, and relatively low salary to overcome the aforementioned issues.

To meet the need for subspecialty surgeries, some hospitals had part-time subspecialty surgeons who traveled to the hospital to perform surgeries on a limited number of days. However, these arrangements did not pay particularly well for these visiting subspecialty surgeons given that many residents of rural counties were uninsured or covered through Medicaid. Thus, it was challenging to establish and maintain relationships between subspecialty surgeons and rural hospitals. One interviewee noted that:

It's back to that same situation of trying to have somebody from a city drive out and have that windshield time to drive out here. You know, they don't always necessarily look at it as the most lucrative, especially with the demographics that we serve.

Access to Postsurgical Care Also Limits Services in Rural Communities

The availability of postsurgical care, including medical subspecialists, also posed a significant challenge to

Figure 1 Overview of Key Themes From Qualitative Findings.

Note: CRNA, Certified Registered Nurse Anesthetist.

provision of surgical services. Although some subspecialty surgeons drive to rural communities to perform surgeries, patients still typically need to drive into the city for any specialized postsurgical follow-up care. One respondent noted that:

We don't have all the different specialties that can take care of the patients. And that's why with us being 45 minutes from a bigger institution, anybody that needs specialized after care would have their surgery there. We always say it's not necessarily the difficulty in getting them through the anesthesia, it's the aftercare.

Hospital Capabilities Limit Potential Expansion of Surgical Programs

Rural hospitals that would otherwise increase surgical programs were limited by availability of various surgery-related capabilities such as ORs, postoperative care and nonphysician staff (eg, critical care nurses, case managers, physical therapists). These hospitals often had a single OR, or they did not have the necessary ICU beds for more complex postsurgical patients.

Rural Hospitals Are Challenged in Expanding Surgery Services by Available Volume

Many interviewees reported finding it difficult to recruit surgeons needed to cover the desired surgical volume until the surgical volume was high enough to cover the additional cost of hiring that individual. One respondent noted that:

I don't think that it is financially feasible to make that kind of expenditure [on equipment and post-surgical care]

to be able to do [heart or lung] surgeries. That all becomes driven by volume in order to cover all that overhead, and you've got to do a certain number of those cases in order to maintain competence. And in a population of 25,000 people in our primary service area, you just wouldn't generate the volume. It's just kind of the curse of the business model.

Anesthesia Services Are Not a Limitation at Rural Hospitals

While rural hospitals relied extensively on CRNAs to provide anesthesia services, when asked “what difficulties does your hospital face in providing services that require anesthesia (procedural, surgical, and/or obstetrical) that your local patients need,” interviewees stated that access to anesthesia services was not a limiting factor in their ability to provide or expand surgical services. The majority of hospitals ($n = 10$) indicated they are operating with a CRNA-only model. Of the participating hospitals that employed or contracted an anesthesiologist, 2 reported that the anesthesiologist on staff did not directly supervise the CRNAs. Overall, CRNAs seemed to have been meeting the needs of the rural hospitals that they served. One respondent stated that “I don't know where we'd be without CRNAs,” and an interviewee in a CRNA-exclusive hospital mentioned:

Anesthesia has covered everything that we've needed them to cover. I can't think of anything that really hasn't been done, because we couldn't get anesthesia.

Another stated that:

There's things that we'd like to add but nothing that CRNAs are limiting. As I mentioned, if we brought out a urologist or another pain specialist, those are things that [the CRNAs] would be able to do...it's more related to physician recruitment versus the CRNA limitations.

When asked about rationale for anesthesia team composition (ie, the balance and number of CRNAs and anesthesiologists), interviewees most commonly responded that the staffing model had been in place for a long time without offering any other justification for the team composition. However, they mentioned that CRNAs were easier to recruit than physicians, given autonomy of CRNA practice in rural communities and relative salaries of CRNAs and anesthesiologists.

Rural Hospitals Are Reliant on CRNAs With Strong, Diverse Skills

Rural CRNAs had a unique role in that they often worked independently of anesthesiologists and therefore needed skills and experience across a number of procedures. One interviewee stated that:

We do require highly skilled CRNAs, since basically we work in a very independent practice. ... There are times where there's only [a] single [CRNA] here in the hospital doing cases. Because of that, the autonomy and the skills and the regional skills that we require here are probably a lot higher than most CRNA practices.

This interviewee went on to explain that anesthesia providers in a large, urban health system often specialize and therefore did not use the generalist skillset necessary to work in a rural hospital. Anesthesia providers with experience necessary to work in rural hospitals were not always easy to recruit but at the same time are often drawn to rural communities where they can be more autonomous.

Rural Hospitals Seem to Be Using CRNAs to the Full Extent of Their Education and Training

CRNAs were practicing to the full extent of their education and training in the majority of hospitals included in our study. In fact, state scope-of-practice and opt-out policies seemed to have limited effect on CRNAs' clinical practice, as only 2 hospitals mentioned that state CRNA policies limited the care that CRNAs could provide even in relatively restrictive states.

Where supervision or collaboration was required by the state, hospitals used creative strategies to maximize CRNA autonomy. Two interviewees mentioned that

rather than having an anesthesiologist or surgeons supervise each case seen by the CRNAs, a physician agrees to a department-wide care plan. One of these 2 hospitals had even amended the hospital by-laws to allow CRNAs to essentially practice independently this way, while technically complying with state law.

The supervisory requirement is not actually for anesthesia services, it is that they agree on the anesthesia plan. So, it's kind of a parsing words a little bit. The surgeon technically yes, they are supervisory in the case but again they don't make specific recommendations to the practice but only to the plan.

Hospitals rarely restricted CRNA practice beyond state requirements. Three hospitals had more restrictive CRNA practice policies than the state regulations; one required CRNA supervision by the surgeon (not the anesthesiologist) in a full SOP state. However, it was the interviewee's belief that this hospital policy did not limit service capacity. Two hospitals restricted labor epidurals, and central lines and peripheral blocks, respectively, to anesthesiologists rather than CRNAs. When asked about rationale for this particular policy, one interviewee reported that this policy enabled the anesthesiologist to justify the salary expenditure to recruit a second anesthesiologist to their hospital, as placing labor epidurals was a way to increase both anesthesiologists' income.

Ongoing Access to CRNAs Is Tenuous at Some Rural Hospitals

Although anesthesia services were not the limiting factor for these rural hospitals, half of the hospitals relied on locum tenens and external contracts with CRNA staffing companies ($n = 8$). These agreements were often with staffing companies that had a small number of CRNAs or with individual CRNAs. Hospitals may therefore have been dependent on a small pool of providers to work at their facilities. Because the pool of CRNAs was small and the hospitals relied on external contractors, access to these providers could change quickly.

We've been very fortunate, I think, to have the coverage that we have had, but I foresee that being [a] future problem. Hopefully, I can find somebody that will do the same thing. It is hard, we can't offer full-time at this point.

Therefore, the provision of anesthesia services was not an issue, although this situation could change in the future (ie, with a single retirement or life change). Although anesthesia providers were not currently limiting hospitals' ability to provide surgeries, rural hospitals may be challenged if they try to expand their services.

Maintaining 24-Hour Anesthesia Coverage Risks Staff Burnout

Although CRNAs have been able to meet the routine, nonemergency anesthesia needs of rural hospitals, respondents reported that obstetrical care and 24-hour emergency surgery continue to challenge the anesthesia workforce in rural communities. Elective surgeries were relatively easy to schedule and maintain the necessary anesthesia and surgical staff. However, maintaining 24-hour and otherwise unpredictable coverage needed for obstetrics and emergency surgeries risked staff burnout:

There's probably more expense involved in making sure anesthesia is available; at least in our system where we have obstetrics and we have emergency surgical cases that happen in the middle of the night or the weekend. But there are hospitals that are small and only provide scheduled surgical care, so the anesthesia provider and the surgeon basically both come into the community during the times that they're working, and their overhead and their presence disappears.

Another respondent stated that:

When there's a competition between needing a labor epidural, needing the OR to flow fluidly, if you will, or efficiently, and they're pulled different directions and have to leave to go do an epidural. Well, that leaves our ORs waiting if there's a general case, because we have to wait for the [anesthesia provider] to be here to start the general case.

Discussion

Findings of this mixed-methods study have a number of important implications for rural surgical practice and policy. We found that rural counties had fewer surgeons per capita than nonrural counties, consistent with previous examinations of surgeon maldistribution and shortages,^{5,6,20-22} and hospital administrators perceive that availability of these surgeons, especially subspecialty surgeons, are the key barrier to providing and, especially, expanding surgical services. Furthermore, hospitals also lack some key capabilities that would allow them to provide postacute inpatient and outpatient care to many surgical patients. This makes it extremely difficult to increase provision or maintain surgical, especially subspecialty, services in rural communities.

Providing surgical services is critical to the financial well-being of rural hospitals and their communities. In the past decade, hospital closures have increased, especially in rural areas.² Reasons for rural hospital closures are multifactorial, but most often result from financial

pressures.²³ While closures may not affect quality of care (ie, if hospitals that close are of lower quality),²⁴ closures nevertheless detrimentally affect access.^{23,25} For example, women need to drive an average 29 additional miles for intrapartum care when obstetric units close.²⁶ Moreover, it estimated that when the sole hospital in a community closes, the local unemployment rate increases an average 1.6% and per-capita income decreases by an average 4%.²⁷ However, the provision of an expanded set of surgical services may be important to avoiding hospital closure in rural areas for financial reasons, as well as the associated negative consequences, because these services are often profitable and support the financial health of rural hospitals and their communities.²⁸ As there is no alternative workforce that can perform the same tasks as surgeons, more research and policy are needed to maintain or increase the presence of surgeons to enable rural hospitals to safely provide surgical services and therefore support the financial health of these hospitals and their communities.

However, it is difficult or impossible to invest in resources needed to cover the desired surgical volume until the surgical volume is high enough to cover the additional cost of investing in that resource (ie, hiring an additional surgeon, building another OR). It is not clear that there will ever be enough demand within many rural hospitals to support a subspecialty surgeon. Many rural hospitals have experimented with having visiting subspecialty surgeons come to the hospital for a few days per week or month to perform surgeries. Some studies have shown that these visiting surgeon programs may be effective in retaining surgeries in rural hospitals.⁷ Moreover, if the rural hospitals cannot sustain sufficient volumes, quality of care may suffer. Although previous studies have found that small rural hospitals perform as well or better than nonrural counterparts for frequent, general surgeries, it remains unclear if the volumes can be sufficient to keep nursing and other staff proficient in meeting the postsurgical needs of these patients.^{29,30}

In addition, our findings may also explain why previous studies did not observe that CRNA opt-out policies were associated with a difference in the use of elective anesthesia¹⁵ or the proportion of patients having to leave their local ZIP Code for a surgery or access to inpatient surgical services.^{15,16} If a majority of rural US counties completely lack various types of anesthesia providers needed to perform surgeries, with more than 80% having no anesthesiologist and 60% having no CRNA, we might not expect a difference in state policy to have any effect on surgical practice and payments of care providers if no providers are present in the county, let alone in the ZIP Code. At the same time, we found that CRNAs were often being used at the top of their license even in the

presence of more restrictive state policies. This is another factor that could obfuscate the effects of these policies.

Limitations

One limitation of our quantitative analysis was that a health care provider can only be associated with 1 county in AHRF, which represents either a residential or professional address. These data do not account for instances in which residential and professional locations differ or if they practice in multiple counties. As such, our results may underestimate surgical and anesthesia workforce availability. This may be especially important in counties that have short-term general hospitals and an operating room but no surgeon. Of note, approximately 42% of counties with a short-term general hospital had no surgeons reported in AHRF. On average, these counties had 0.82 operating rooms and performed a very small number of inpatient surgeries per year (mean = 71.2). This suggests that surgeons likely live elsewhere and travel to these rural communities to perform a very small number of inpatient surgeries. Another limitation is that for the qualitative work, the participation rate for the interviews was relatively low. While this may indicate limited generalizability of this sample, we achieved the sampling diversity intended by state policy and critical access status and there are significant differences between participants and nonparticipants (Table 2). Furthermore, we also appeared to reach data saturation on key questions of interest.

Conclusions

Our study found significant disparities in surgical and anesthesia workforce across rural and nonrural communities in the United States. These differences in access, especially to surgeons, likely limit rural hospitals' abilities to expand into new surgical subspecialty areas. It is especially difficult for rural hospitals to perform surgeries at the volume necessary to support safe and profitable subspecialty surgeries. Because hospitals rely heavily on revenue generated from surgeries, it is likely that rural hospitals' challenges expanding their surgical offerings will continue to threaten the financial viability of rural hospitals. At the same time, although similar disparities exist for anesthesia providers, hospital administrators report that anesthesia workforce does not limit hospitals' abilities to provide surgical services. CRNAs, who provide the bulk of rural anesthesia, are well-trained and highly skilled. However, due to the nature of emergency and obstetrical services, the provision of anesthesia services continues to be challenged in terms of burnout of the current anesthesia staff as well as challenges in hiring new staff to work in rural hospitals.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix. State Policy Categories Used for Stratification of Sample for Qualitative Recruiting