



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

## Current Problems in Surgery

journal homepage: [www.elsevier.com/locate/cpsurg](http://www.elsevier.com/locate/cpsurg)

## Rural surgery



David C. Borgstrom, MD, MBA<sup>a,\*</sup>, Karen Deveney, MD<sup>b</sup>,  
 Dorothy Hughes, PhD, MHSA<sup>c</sup>, Isolina R. Rossi, MD<sup>d</sup>,  
 Matthew B. Rossi, MD<sup>e</sup>, Randy Lehman, MD<sup>f</sup>,  
 Stephanie LeMaster, MD<sup>g</sup>, Mark Puls, MD<sup>h</sup>

## Surgery as an economic engine in rural America: where are we?

–Dorothy Hughes, PhD, MHSA

Since March 2020, researchers have been examining COVID-19 and its impacts on rural hospitals, health care professionals, and communities. The pandemic has increased the strain on rural health professionals and their communities, not only the strain on their health but broadly on their well-being, including their economic well-being. Rural hospital closures, even before the pandemic, had been trending upward, a worrisome direction for rural residents' access to care.<sup>1</sup> Rural residents have long experienced health disparities due to health professional shortages, a dearth of resources, social risks, and environmental factors.<sup>2</sup>

Our objective here is to discuss surgery as an economic engine in rural America. We discuss the evidence around the relationship between rural hospitals' financial health and their communities' economic well-being, between surgical services and rural hospitals' financial health, and, therefore, between rural surgeons and their communities. The evidence suggests that all 3 of these relationships are bidirectional. Given the spate of rural hospital closures and the adverse impacts to date of COVID-19 on rural America, we conclude by suggesting where rural surgery stands as an economic engine in 2021 and what future directions surgeons, the profession, and health services researchers may want to consider.

From the <sup>a</sup>General Surgery Residency Program, West Virginia University, Morgantown, WV; <sup>b</sup>Oregon Health & Science University, Portland, OR; <sup>c</sup>Departments of Population Health and Surgery, University of Kansas School of Medicine—Salina, Salina, KS; <sup>d</sup>Department of General Surgery, Carolinas Medical Center, Charlotte, NC; <sup>e</sup>Department of General Surgery, Hopedale Medical Foundation, Hopedale, IL; <sup>f</sup>Pulaski Memorial Hospital Medical and Surgical Group, Winemac, IN; <sup>g</sup>MidMichigan Physicians Group, Alpena, MI; and <sup>h</sup>Alpena, MI

\* Address reprint requests to David C. Borgstrom, MD, MBA, Program Director, General Surgery Residency Program, West Virginia University School of Medicine, P.O. Box 9238 HSC South, One Medical Center Dr, Suite 7700, Morgantown, WV 26506.

E-mail address: [absd@gmail.com](mailto:absd@gmail.com) (D.C. Borgstrom).

<https://doi.org/10.1016/j.cpsurg.2022.101173>

0011-3840/© 2022 Published by Elsevier Inc.

## *Rural hospitals' financial health and rural communities' economic well-being*

Hospitals are critical to the economic well-being of their communities, particularly in rural areas.<sup>3</sup> They are often one of the largest, if not the largest, employers in their localities. Each person employed by a hospital is a person who is also spending money at local businesses, part of a positive ripple effect or, in economic terms, a multiplier effect. This draws the first direct line from rural hospitals to the local economy.

A study using data collected in 1979 found that more than half a million dollars and potentially just more than \$1 million in community income were created by each studied rural hospital.<sup>4</sup> Even then, in the late 1970s, authors noted rural community hospitals usually had occupancy rates of less than 50%. A 1991 study found that each hospital bed produced \$54,739 of economic impact for its community.<sup>5</sup> Using this estimate, we could extrapolate that a 25-bed critical access hospital could potentially have an impact of \$1.3 million. Authors noted that significant policy changes affecting health care reimbursement had occurred in the preceding decade, from approximately 1979 to 1991. Other studies from the 1990s and then into the 2000s similarly found that hospitals had impressive positive economic effects in the forms of increased local income and greater retail sales and sales tax dollars.<sup>6,7</sup> Just as hospitals have positive economic effects, hospital closures have detrimental effects on local economies. Although the loss of a hospital in a community that has more than 1 hospital may not have detrimental long-term consequences, the loss of the only hospital in a community does.<sup>8</sup> Hospitals benefit their communities in direct and indirect ways, and they also represent an important amenity.<sup>8</sup>

The reality in the United States is that any health care organization's financial health revolves around the insurance status of the populations they serve. They can only produce the aforementioned positive economic effects if their revenue streams, dependent on third-party payers, remain strong. Since in the United States, health insurance is primarily employer-based, regardless of where one lives, a rural hospital's revenue streams are directly tied to their communities' employers and what health insurance options are offered to those employees. This draws a direct line from a community's economic well-being to the financial health of its health care organizations.

Approximately 92% of Americans have health insurance, and approximately 55.4% had employer-provided coverage as of 2019.<sup>9</sup> An additional 12.6% have some other form of private insurance, and approximately 38% are publicly insured through programs such as Medicare and Medicaid.<sup>9</sup> Those who are self-employed seek health insurance on the open market, either through brokers or the health insurance exchanges set up by the Affordable Care Act (ACA).

Rural areas should consider 2 key points: (1) whether insurance patterns are different compared to urban areas and (2) the demographics of their populations. First, the insurance patterns for farm and non-farm families are not significantly different; often, farmers also work off-farm, and if not, the person may have a spouse who works off-farm. Therefore, farm families often have similar access to employer-based insurance as in less agriculturally-based areas.<sup>10</sup> Second, rural areas typically have higher proportions of their populations over the age of 65 years, making them eligible for Medicare, and therefore, automatically having health insurance coverage. This suggests that although rural hospitals are more dependent on Medicare reimbursement than their urban counterparts, on average they should have relatively similar revenue, proportionately, from employer-based insurance.

Aside from Medicare, the other major public insurance mechanism is Medicaid. It, in contrast to Medicare, varies from state to state, partly due to uneven adoption of the ACA's Medicaid expansion provision, but primarily due to the nature of the program. Medicaid is a joint state-federal endeavor, and states have always had significant flexibility in establishing their eligibility criteria, benefits, and reimbursement rates. It should be noted that state reimbursement rates vary significantly, and these rates can be so low in some areas that providers choose not to participate in the Medicaid program at all. Since the United States does not currently have an individual health insurance mandate in place, people have the option of remaining uninsured. Many remain uninsured because the costs of available insurance plans are too high. Uninsured

individuals are at significant financial risk, and if they make decisions about seeking care based on cost, they may delay or go without care.<sup>11</sup> Rural providers, operating on already thin financial margins, must consider how these unmet needs may grow and result in more serious medical conditions than otherwise may have occurred. This may mean adverse outcomes, including death, for the individual, but also greater resource expenditure by providers who strive to deliver the best care regardless of payer. Efforts to increase health insurance coverage, including through Medicaid expansion, have been shown to decrease hospitals' uncompensated care burdens. Particularly for rural hospitals, this can mean the difference between closure and remaining open.<sup>12-14</sup> Reimbursement rates from Medicaid programs to hospitals and physicians, across the country, are typically lower than rates from Medicare and private payors.<sup>15</sup> However, they are at least greater than zero.

Rural hospitals and their local economies have a bidirectional relationship in that when the hospital does well, it is good for the community, and when the community does well, it is good for the hospital. Those interested in fostering the financial well-being of rural hospitals and the surgeons who operate there should be concerned with hospital employee retention, area employment and economic development generally, local employers' health insurance offerings, and caring for the Medicare population. Addressing the health insurance coverage status of one's population requires a multi-pronged approach including state-level policies improving Medicaid reimbursement rates and expanding Medicaid eligibility, and federal-level policies such as making ACA insurance exchange plans more affordable and improving Medicare reimbursement rates.

### *Surgical services and rural hospitals' financial health*

The evidence shows that profitability is the most important predictor of hospital closure.<sup>1,14</sup> It is a crucial predictor of rural hospital viability and is tied to population insurance status. Although surgical procedures are often resource-intensive and therefore costly for hospitals to provide, they also offer the chance to generate significant revenue.<sup>16</sup> Rural hospitals may want to consider less resource-intensive developments in surgery, such as minimally-invasive procedures. It may be possible to maximize the services available to one's rural population by offering more of these less-costly services, then making tough choices about additional, more expensive services based on population needs and the distances to higher levels of care.

In 2005, researchers found that rural hospitals were "relying disproportionately on revenues associated with surgical services." Among hospitals in that study, surgical services accounted for approximately 30% to 40% of total revenue.<sup>17</sup> One reason is likely the wide variety of services that a general surgeon may be able to provide.<sup>18-20</sup> Doty and colleagues in 2008 found that the type of surgical services offered by hospitals varied by rurality, with approximately one-third of hospitals in very small rural areas (populations of <2500) relying solely on outpatient surgery. The inverse is that approximately 66%, even in very small rural areas, offered inpatient surgery. Approximately 93% of hospitals in small rural and 100% in large rural areas offered both inpatient and outpatient surgery.<sup>16</sup> In 2020, Cohen and colleagues found that among rural counties with at least a short-term general hospital, 50.8% were without a general surgeon, and slightly more, 52.2%, were without any surgical specialists.<sup>21</sup> Although these studies do not offer an apples-to-apples comparison, taken together they imply a dire situation in 2020, with one-half of all rural counties having no surgical services.

As researchers found in 2015, more than twice as many hospitals defined as "rural, short-term acute" closed in 2013 and 2014 compared to 2011 and 2012.<sup>1</sup> At the same time rural hospitals are closing, rural areas continue to suffer from workforce shortages, with fewer primary care physicians and mental health providers per 100,000 people than in urban areas. The surgical workforce shortage persists as well, with 4.2 surgeons per 100,000 compared to 6.9 in urban areas.<sup>21</sup> Germack and colleagues found that communities with hospital closures had experienced decreases in the number of general surgeons prior to a closure. After closure, this decline continued.<sup>22</sup> The US Government Accountability Office found that from 2012 to 2017, counties that

experienced hospital closures saw a decline of 36.4% in the number of general surgeons. Even counties without closures saw a decline, but a smaller one, at 5.0%.<sup>23</sup> The availability of surgical services in rural areas is connected to both the surgical workforce shortage and the closure of rural hospitals. The evidence suggests that rural areas with difficulty retaining surgeons may also be areas in which hospitals are at risk of closure.<sup>1,18,22,24</sup>

Unfortunately, a serious shortage of surgeons has been predicted for the entire nation into 2040, and the shortage in rural areas will be exacerbated.<sup>18,24–27</sup> Hospitals that remain will need to hire surgeons. Urban hospitals will need to hire more surgeons than rural hospitals, but the competition that will produce may make it difficult for rural hospitals to compete and hire even the smaller numbers they need.<sup>28</sup> Health care delivery has been trending away from inpatient services for decades, but surgeons operate, literally, in both the inpatient and outpatient realm, which means they continue to be relevant regardless of this trend. The relationship between surgeons and administrators may vary, anywhere from friendly to adversarial, but the reality is that in a rural setting, they have no choice but to work together, as neither has the resources to break away from the other. Rural administrators need surgery; surgeons need operating rooms.<sup>18</sup>

The evidence around the relationship between surgical services and rural hospitals' financial well-being shows this relationship is bidirectional. As the Germack study implied, as surgeons leave, hospitals may be at increased risk for closures, but also, as hospitals close, surgeons leave in response.<sup>22</sup> Rural hospitals are heavily reliant on surgical services for revenue, but so too are rural surgeons reliant on their hospitals for their livelihoods.

### *Rural surgeons and their communities' economic well-being*

The fates of rural surgeons and rural hospitals are inextricably linked, just as the fates of rural hospitals and rural communities are inextricably linked. Although it is possible for rural hospitals to exist without providing surgical services, the evidence is clear that where there are rural surgeons providing a robust continuum of surgical services, rural communities are reaping a significant economic benefit that they would not otherwise. A community's economic well-being is intertwined with its residents' well-being, and certainly, as hospitals have closed and health care services have diminished, those residents are worse off.

For example, in 2012 there were 42 rural hospitals that closed that had offered inpatient surgery.<sup>23</sup> In 2012 prior to closure, the next-closest inpatient surgery location was on average 3.3 miles away. By 2018 (after closure), that distance had grown to an average of 22.5 miles.<sup>23</sup> Longer distances to travel can affect clinical outcomes directly,<sup>17,29</sup> but they also have economic consequences for patients in the form of travel costs, more time needed off work, and potential disconnection from their support network of family and friends.<sup>30</sup> This mechanism—proximity of surgical services—creates a direct relationship between rural surgeons and their community members' economic well-being. We can see the relationship is bidirectional by returning to the evidence on insurance coverage. When communities have a robust, diverse employer base that offers quality health insurance to its employees, that benefits the community's surgeons in turn.

Saint Onge and Smith<sup>31</sup> conclude that the demographic trends most pertinent to rural surgeons are continued population loss, rising death rates, and ever-increasing diversity. Rural areas on average have a higher proportion of their populations in the over-65 age category, lower household incomes, higher child poverty rates, and higher all-cause mortality rates.<sup>32</sup> This means rural surgeons' patients are typically older and sicker, but it is too narrow to think only about patients. These characteristics also describe the population that rural surgeons live with as friends and neighbors; they shape the social fabric of rural places, and they affect those places' economic potential. This illustrates how complex and multi-factorial the surgeon-community relationship can be.

The characteristics of a place have been shown to affect rural surgeon recruitment and retention.<sup>33,34</sup> This phenomenon has been more commonly studied among rural primary care physi-

cians and rural health professionals broadly.<sup>35–42</sup> Recruitment and retention represent a clear and actionable connection between rural communities' economic health and rural surgeons. Those in rural communities may want to consider how to take maximum advantage of economic development programs and/or recruitment and retention programs or incentives in their areas.

### *Where surgery stands as an economic engine for rural America*

As of 2021, surgery remains an important economic engine in rural America. However, it has taken a serious hit during the COVID-19 pandemic. In March 2020, elective operations were suspended across the country, with suspension lengths varying by locality.<sup>43,44</sup> This was detrimental to rural hospitals, which rely more on elective operations to cover costs than do their urban counterparts.<sup>45</sup>

At the start of the COVID-19 pandemic, rural areas were at higher risk for severe disease and higher mortality due to larger proportions of their populations having underlying conditions, being older, lacking health insurance, and living long distances away from hospitals with intensive care unit (ICU) capabilities.<sup>2</sup> According to the American Hospital Association (AHA), 18 rural hospitals closed in 2019.<sup>46</sup> In 2020, 19 rural hospitals closed.<sup>47</sup> Although the bidirectional nature of the relationship between hospitals and surgeons can be used to “spiral up,” allowing both to grow and improve, in the pandemic it seems to have been a vicious cycle. As hospitals have suffered, so then have surgeons and vice versa.

The link between rural surgery and rural hospitals is unlikely to be broken, but those interested in improving rural health need to consider how to strengthen the relationship in a post-COVID (or ongoing COVID) world. The AHA is advocating for a range of new care delivery models that would allow rural hospitals flexibility in what services they offer, with the goal of increasing long-term financial viability.<sup>48</sup> Rural surgeons will want to consider how surgery fits into those models; for example, if services are reduced so as to lower hospital costs, would that mean all surgical services are cut, or only those requiring ICUs? If rural hospitals move toward emergency care models and offer little to no inpatient care,<sup>3</sup> surgeons will want to consider what services are practical for them to provide in that new setting.

### *Conclusion*

The evidence for rural surgery as an economic engine shows three key bidirectional relationships: rural hospital financial health and community economic health, surgical services and rural hospital financial health, and rural surgeons and their communities' economic health. Rural hospitals represent direct and indirect economic benefits, and they are important amenities that enhance quality of life. Hospital employment draws a direct line from rural hospitals to their local economies. Our employer-based health insurance system creates a direct link between communities' economies and the financial health of rural hospitals. When a hospital does well, it is good for the community; when the community does well, it is good for the hospital. Research also suggests that rural areas with difficulty retaining surgeons may also be areas in which hospitals are at risk of closure. Community economic health is related directly to rural surgeons through surgeon recruitment and retention. As economic well-being increases, recruitment and retention may be easier, but also, as recruitment and retention are more successful, so too may a community see a rise in its economic health. With a more robust continuum of care available, rural areas are more attractive to companies deciding where to locate.

Anyone seeking to utilize these bi-directional relationships to improve the lives of rural residents, rural surgeons, and rural hospitals should consider the range of public policies affecting these dynamics. These include policies making private health insurance coverage more affordable and available, reimbursement rates for Medicare and Medicaid, local economic development programs or incentives, policies and programs aiding rural surgeon recruitment and retention, and new rural care delivery models.

## Optimal training of the rural general surgeon

*-Isolina R. Rossi, MD, and Matthew B. Rossi, MD*

Rural surgeons are in short supply and reversing this workforce deficit has become an urgent matter.<sup>49</sup> The economic impact of a rural general surgeon on the community and hospital is well-documented.<sup>50</sup> Rural surgeons are a heterogeneous group with some operating in geographically remote areas with limited specialty support or backup. Others practice in communities of 10,000 or larger with graduated access to hospital resources and specialists.

As a group, rural surgeons enjoy the close-knit community and the life-long relationships they share with their patients and families. The doctor-patient relationship is made even stronger as rural surgeons provide a variety of life-saving and elective services to multiple generations of the same family.

The dictum that a properly trained general surgeon should be capable of caring for “the patient’s skin and its contents” rings especially true for rural surgeons and could even be modified to the care of “the patient’s skin, its contents, and kin!” Studies have shown that the typical rural surgeon has broad-based training in general surgery, as well as endoscopy and a multitude of surgical subspecialties.<sup>51–54</sup> This allows the rural surgeon to be resourceful and creative. In practice, they can draw on the “tricks of the trade” learned from various surgical specialties, from a rural mentor, or as self-taught skills.

A comprehensive review of procedure codes for all rural surgeons in North and South Dakota revealed that one-eighth of a rural surgeon’s practice is specialty procedures, which represented more than 20% of their non-endoscopy practice.<sup>51</sup> As the surgical field has become more specialized, most modern general surgical residencies no longer provide broad-based general surgery training to their residents, with nearly 80% of residents seeking fellowship training.<sup>55</sup>

As rural surgeons and their allies work to raise awareness and recruit medical students/residents to a career in rural surgery, it is not surprising that these individuals are seeking out programs that are committed to providing a broad training experience. Recent efforts by the American College of Surgeons through the Advisory Council for Rural Surgery have attempted to provide this information by identifying surgical training programs with a rural focus. These programs vary widely in their construct. Some programs are intrinsically rural in their location yet have enough volume and diversity necessary to expose the resident to endoscopy and subspecialty surgical specialties without necessarily creating a designated “rural track.”<sup>56–58</sup>

Rural surgery training tracks focus on operative variety and exposure to subspecialty rotations. The common program structures consist of either a rural rotation, a dedicated track with subspecialty and rural rotations, a dedicated year of rural surgery, a fellowship, or a Mastery in General Surgery Program (formerly Transition to Practice Program).<sup>59</sup>

More commonly, the residency will arrange required or elective subspecialty surgical rotations at a remote hospital for 1- to 3-month periods during the second to fourth postgraduate years. The immersion approach consists of a comprehensive rural surgical experience either as the resident’s fourth postgraduate year, a research year, or as a fellowship after completing residency.

For the most part, these curriculum changes have been supported by the Residency Review Committee of the Accreditation Council for Graduate Medical Education (ACGME) and American Board of Surgery (ABS) as “flexibility in training effort”<sup>56</sup> (for example, allowing the resident’s fourth postgraduate year to count as a chief year and allowing the resident to train off-site during the fifth postgraduate year).<sup>60</sup> Some programs have been permitted additional resident training slots if designated to a rural track.

Within the context of these varied program models, the authors have previously delineated what we feel are the critical components of a successful rural surgery training program (Table 1). A previous publication attempted to identify those programs which exhibit these attributes.<sup>61</sup> This has proven difficult due to inconsistencies and incompleteness in program websites. With increased awareness, there has been a substantial increase in interest on the part of

**Table 1**

Essential components of rural surgical training programs.

---

Clinical experience in rural settings
Robust diagnostic and therapeutic endoscopy experience
Exposure to diseases and procedures in surgical subspecialties
Absence of competing learners on surgical rotations

---

\*Refer to: Rossi IR, et al. 2020. "Rural Surgical Training in the United States: Delineating Essential Components within Existing Programs." *The American Surgeon* 86 (11): 1485-1491.

**Table 2**

Core content areas of general surgery defined by the American Board of Surgery, February, 2017.

---

Alimentary tract (including bariatric surgery)
Abdomen and its contents
Breast, skin, soft tissue
Endocrine system
Solid organ transplantation
Pediatric surgery
Surgical critical care
Surgical oncology
Trauma, burns, and emergency surgery
Vascular surgery

---

training programs to address the needs of rural surgeons and promote this as a career opportunity for students and residents. These types of programs are also ideal for those interested in global surgery or military duty. This is an important time to identify conceptually the components of the ideal rural surgical training program, as this will provide guidance to students, residents, and institutions that are committed to this cause.

### *The rural experience*

Since most surgical residents train in urban settings, it is critical that they rotate through a rural hospital to gain exposure to the practice and lifestyle of rural surgery. Anecdotally, the challenges of a rural practice revolve around geographic isolation, lack of access to specialists, and minimal backup. Having exposure to these challenges can assist trainees in identifying whether or not a rural surgical practice is an environment in which they could be happy. Additionally, the rural setting usually affords the resident endoscopy experience with a surgeon instructor and exposure to other surgical specialties without competing residents. The bulk of the trainee's general surgical experience will usually occur at the larger teaching hospital, where there are greater volumes and complexity of cases.<sup>56,62</sup> The ultimate goal should be to obtain broad training within the 10 core content categories as defined by the ABS in addition to the rural rotations (Table 2).<sup>57,58</sup>

### *Endoscopy*

The rural surgeon usually serves as the endoscopist in small communities. The literature consistently shows that endoscopy represents 40% to 60% of a rural surgeon's operative procedures. Many surgical residencies struggle to provide their trainees with the minimum required endoscopy numbers.<sup>52,62,63</sup> A robust experience with diagnostic and therapeutic endoscopy is optimal for these trainees. Management of peptic ulcer disease, gastroesophageal reflux disease (GERD), Barrett esophagus, acute gastrointestinal (GI) bleeding, extraction of foreign bodies, simple and complex polypectomy, endoscopic retrograde cholangiopancreatography (ERCP), and esophageal and colonic stenting are all important skills for the rural surgeon who may be practicing in an environment without GI specialist support. The lack of adequate endoscopy experience disqualifies many surgical programs from being considered rural-focused.



**Table 3**

Examples of surgical specialty procedures for rural surgeons in training.\*

Specialty area	
OB/GYN	Caesarean section Ectopic pregnancy D&C Tubal ligation Hysterectomy Cystocele and rectocele repair Vaginal prolapse Birth canal trauma Complications of IUD's
Urology	Cystoscopy Placement of difficult catheters Suprapubic tubes Ureteral stenting Ureteral repair Testicular torsion Nephrostomy tube Nephrectomy Vasectomy
Gastroenterology	Upper and lower endoscopy Difficult polypectomy Bleeding control ERCP Esophageal and colonic stenting Foreign body retrieval
Orthopedics/hand surgery	Carpal tunnel Cubital tunnel Trigger finger Ganglion Hand trauma and infection Common dislocations and fractures
ENT	Foreign body retrieval Peritonsillar abscess Facial trauma Tonsillectomy
Plastic surgery	Common flaps Burns Complex lacerations Oncoplastic breast procedures
Interventional radiology	Ultrasound- and CT-guided biopsy and drainage of abscess Image-guided biopsy and wire placement for breast lesions
Thoracic surgery	Trauma VATS Flexible and rigid bronchoscopy Esophageal injury

CT, computed tomography; D&C, dilatation and curettage; ENT, ears, nose, throat; ERCP, endoscopic retrograde cholangiopancreatography; GYN, gynecology; IUD, intrauterine device; OB, obstetrics; VATS, video-assisted thoracoscopic surgery.

\* As determined by survey of practicing members of the American College of Surgeons Rural Advisory Council.

### *Surgical subspecialties*

Rural surgeons may be called upon to perform a variety of procedures that otherwise would be performed by a specialist in the urban setting. Some of these may require immediate life or organ-saving intervention as in the case of emergent Caesarean section or testicular torsion. Exposure to a variety of surgical specialties is optimal (Table 3).<sup>52,58</sup> This may take the form of structured 4- to 6-week rotations on a given service, or rotations at a community hospital without competing residents in these specialties. It is important for the rural surgical trainee to be familiar with the disease presentation, evaluation, and surgical management of a variety of

non-general surgical conditions. Although it is not likely that the trainee will become proficient at all these procedures, it is helpful to have exposure in order to develop the resourcefulness and creative problem-solving that is characteristic of a broadly trained general surgeon.

Interventional radiology deserves special mention as these services are many times unavailable in rural hospitals. Ultrasound and computed tomography (CT) guided biopsy and drain placement for chest and abdominal lesions as well as biopsy and localization of breast lesions can be an extremely useful addition to the rural surgeon's skill set, and a tremendous benefit to the patient.

### *Absence of competing learners*

The rural trainee must also be afforded operative exposure in the aforementioned specialties without competing learners. For surgical residents rotating on general surgery services, having a postgraduate fellow rotating on the service concomitantly will generally dilute the resident's operative experience.<sup>63–65</sup> This is particularly true for vascular, colorectal, and hepatobiliary surgery, all of which are vitally important training cases for the rural surgeon. It is even more important when the general surgical resident is rotating with a surgical specialty, as the presence of competing learners from that specialty will likely be given priority when assigning operative cases. Those training programs which have few or no competing fellows/residents rotating with the rural surgical resident should be considered ideal.

### *Primary care*

Rural surgery encompasses primary care in many communities. Some rural surgeons, including the senior author, do indeed practice family medicine alongside their surgical practice. This provides extraordinary continuity of care and has been associated with excellent surgical outcomes.<sup>66</sup> The rural surgeon in a low-volume setting may find a primary care medical practice to be an excellent means of alleviating regional shortages of primary care physicians, and lead to additional surgical and endoscopic procedures which otherwise likely would not have been referred to them. Ideally, exposure to primary care medicine should be part of the total experience that makes up the rural rotation of the surgical resident. It is infinitely easier to teach a surgeon primary care medicine than to teach an internist to operate!

### *Creating a culture with broad-based goals*

For a rural training program to be successful, the departmental chairman must set the tone for the program director and teaching staff. The residents should be expected to have knowledge of all their patients' disease conditions, not only the general surgical disease. The chairman must create a robust endoscopy experience, if not in the main teaching hospital then perhaps at a smaller community hospital. The chairman should be free of financial or professional conflicts which would impair their ability to establish training opportunities in subspecialties. The residency program should avoid fellows on all teaching services when the rotating resident is planning a career in general surgery (and especially for those not planning a postgraduate fellowship). Except in the case of intrinsically rural programs, the leadership will need to identify the proper settings for the rural rotation and specialty exposure of those residents planning a career in rural surgery. If these goals cannot be met, the rural-interested resident will likely require postgraduate training or mentorship in order to meet their career needs.<sup>53–55,58,63–65</sup>

### *Customize the training to match the target community*

When possible, the rural training scheme should match the target community in which the graduate will be practicing. For example, if there is a need for coverage for emergency Caesarean sections, then this must be addressed during training. If there is no orthopedic surgery coverage and the community is remotely located, then additional training on fracture management would be indicated. If the graduate plans to develop a practice in primary care, then exposure could be increased during rural site rotations. Alternatively, joining a practice alongside a surgical mentor can be an optimal way to fill in the gaps of subspecialty training.

### *Continuing education and support for the rural surgeon*

Professional isolation, lack of call coverage, and difficulty participating in continuing medical education (CME) have long been cited as headwinds to recruiting and retaining rural surgeons. Interaction via electronic media and video conferencing have been immensely helpful. Creative mentorship support either through video or on-site visits could be extremely beneficial, especially to the solo rural surgeon. This could also include periodic call coverage to allow the rural surgeon to travel since many of them are "one call" around the clock without backup. As a result of the recent pandemic, there has been a rapid development of virtual platforms which demonstrates the opportunity for continued education and collaboration in remote locations.

### *Conclusion*

Many available models have been successful in broadly training general surgeons in preparation for a career in rural surgery. The definition of rural surgery is fluid and varies by community needs. To date there has been no scientific analysis published which documents superiority of any given approach. We identify components of what we consider an ideal training program for rural surgeons. This includes experience in a rural setting, robust endoscopic experience, broad exposure to many surgical subspecialties, and rotations free of fellows/competing learners to maximize the operative experience. Such a learning environment will not be achievable at all large metropolitan programs and must be deliberately cultivated by residents and faculty.

### **When surgical training meets the reality of rural surgical practice: "you can do C-sections or carotids, but not both"**

*-Randy Lehman, MD*

This advice was passed down to me second-hand by a mentor and, to my knowledge, was first stated at least 40 years ago. The advice seems to still ring true today.

A simplified view is that a general surgeon may have 1 of 2 types of "broad-spectrum" practice. Urban hospitals offer the luxury of ICU care, specialists in obstetrics/gynecology, orthopedics, urology, otolaryngology, and plastic surgery. An urban general surgeon may have a broad-based general surgery practice including complex cases within classic core general surgery disciplines such as vascular, thoracic, or hepatobiliary surgery. In a small rural hospital, "broad-spectrum" practice can take on a much different meaning. In an area where specialists are scarce, broad practice often includes hysterectomy, carpal tunnel release, tonsillectomy, and skin excisions while certain high-acuity general surgery cases such as Whipple, esophagectomy, and major vascular operations are excluded.

Medical students less commonly choose general surgery and more frequently choose fellowship training over broad-spectrum rural practice.<sup>67</sup> A relative decrease in rural surgery

supply despite stable demand has been documented for at least 60 years, continues to occur in the most recent decade and is projected to continue into the future based on 20-year modeling.<sup>68</sup>

The challenges in filling the need for rural surgeons have previously been analyzed and multifactorial etiology has been described.<sup>69</sup> Commonly cited issues include lack of broad-based residency training, increased specialization, desire for a lifestyle that includes protected time for family and leisure pursuits, increased technology, increased workload for an aging population of general surgeons, and decreased reimbursement. Quality metrics are also essential, and recent Mayo Clinic reports show that a non-volume outcome approach can be successful at tracking quality in rural locations.<sup>4</sup>

Surgical residencies with an interest in training surgeons for rural practice have been calling for broad-based training for years.<sup>70-72</sup> Many programs have been largely independently developed to produce general surgery graduates with this training.<sup>73</sup> We are at a moment in history when the outcomes of these interventions should be further studied. What are the graduates actually doing? Is it enough to call a surgeon a "rural surgeon" based on practice location alone, or is a practice that includes obstetrics/gynecology, orthopedics, urology, otolaryngology, and plastic surgery a requirement? What does rural America really need from a general surgeon?

These pointed questions are personal to me. In July, 2020, I began my practice in rural north-west Indiana following completion of a novel rural general surgery training track at the Mayo Clinic.<sup>74</sup> The COVID-19 pandemic and its associated volume contraction had temporarily subsided, and elective surgery had resumed by the time of my arrival. I viewed myself as a surgeon choosing the Caesarean sections over carotid surgery.

Although I embraced the role as a champion for rural surgery, my youthful zeal had been balanced with a generous dose of wide-eyed naiveté. Through reading and experience as a medical student and resident, I was acutely aware of the broad and theoretical challenges facing rural surgery. Yet, applying my training to real practice and attempting to solve the rural surgery access issue in my small corner of the world was an entirely different challenge.

The following are 10 key takeaways from my first year in practice that I hope will help aspiring rural surgeons and their mentors as we collectively work to provide for a vulnerable and valuable population, rural Americans.

### *A rural American surgical practice can be as varied as the rural American counties themselves*

The US Census Bureau admits that defining rural can be a challenge, and often, rural is defined as anything non-urban. Most recently, The Census Bureau uses criteria including total population thresholds of 2500 people, density, land use, and distance to define urban areas. Outside of these urban areas, 19.3% of the United States population resides in a defined rural area.<sup>75</sup>

These rural populations can be further separated by county, and we witness wide heterogeneity between counties. For example, rural counties can include: counties with defined land area of 99.9% rural yet immediately adjacent to urban cores, individual county population counts as high as 34,457 people, or vastly remote counties hundreds of miles from an urban core with populations as low as 82 people. Much like the range of rural populations, the spectrum of practice of rural general surgeons is also quite varied and difficult to place into a single neat category. It is easy to understand that a rural surgeon in central South Dakota may have a different practice due to community needs than a surgeon in a mostly rural county in Maryland.

### *Colonoscopy and EGD can be the most common procedural CPT codes, yet may not take up the majority of a rural surgeon's time*

In reviewing all procedures from the first year of my practice, colonoscopy and EGD codes comprised 33% of my procedural Current Procedural Terminology (CPT) codes, including 154 to-

tal CPT codes for 96 individual patients. By my estimate, these procedures took approximately 5% to 10% of my 40-hour workweek. Other sources cite that up to 62% of a rural surgeon's practice can be endoscopy, demonstrating once more that the practice of rural surgeons is highly variable.<sup>76</sup>

To the aspiring rural surgeon who desires to "heal with steel" rather than a flexible endoscope, take heart; despite the high percentage of CPT codes, the time required for me to generate these volumes took only about 10% of my time, or perhaps one dedicated endoscopy day per week at the most.

#### *Plan for volumes by looking at demographics*

"At 40 cases per month, you will be bored. At 60 cases per month, your home life will suffer. Shoot for 50 cases per month." This advice was provided by a beloved mentor who did not perform endoscopy and was a busy community non-rural surgeon. Another mentor aimed to average one case per day. The appropriate volume is highly variable, surgeon specific, and case type-specific. Fifty skin excisions and endoscopies is quite different than 50 vascular or thoracic cases. Other authors have described average rural surgeon case volumes from 224 to 1071 per year.<sup>77,78</sup>

My practice for one year included 458 CPT codes in 38 distinct categories, although this included many skin procedures which were performed in a clinic setting. My most common procedure was a skin excision/biopsy/closure code, with 95 total CPT codes on 49 distinct patients for a total of 21% of my procedures. Many of these were performed in a clinic setting. Next was colonoscopy, at 19%, and EGD, at 14%, of total procedures.

General surgeon to population ratio has decreased over the last 2 decades. Proportionately more surgeon loss has occurred in rural communities. From 2001 to 2019, national surgeon to population ratio decreased from 1 per 15,625 to 1 per 19,084. During the same time, rural surgeon per population decreased from 1 per 16,807 to 1 per 23,697.<sup>79</sup>

The graduating rural surgeon must balance isolation and call coverage with the volumes required to sustain a fulfilling surgical practice. In my practice, we have 3 surgeons covering a 13,000 population county. Although we have a reach into surrounding counties, practice volume consideration has led to my search for additional cases through locums tenens work and privileging at a neighboring county hospital.

I recommend looking at demographics and planning to cover a large enough population to sustain your desired practice, giving due regard to current surgeons in the area. Keep in mind that this can be a moving target, as existing surgeons retire or leave the area and additional surgeons enter practice nearby. Many options are available to increase or decrease your practice volume over time.

#### *C-sections and endoscopy are currently the needs most in demand in addition to bread-and-butter general surgical operations*

Demand exists for a rural surgical practice with endoscopy and subspecialty cases not usually within the scope of practice for an urban surgeon.<sup>80</sup> What I did not appreciate until exploring the current field of locums' surgery was the specific demand that existed for just 2 skills: C-section and endoscopy.

Not once was I asked if I could perform carpal tunnel, trigger finger, rotational skin flap, hysterectomy, tympanostomy tube, ovarian or testicular torsion operations, tonsillectomy, or robotic surgery. However, without fail, I was asked by every recruiter if I was willing to perform C-section and/or endoscopy. Upon questioning of a particular locums tenens company, I found that for a large midwest multistate area, there were dozens of jobs available with the need for these 2 skills, but only myself and one other currently active locums tenens surgeon were willing and able to perform C-section and endoscopy.

The need for multispecialty training is important, particularly in a location without competing residents or fellows. But a rural surgical trainee should remember to apply the Pareto Principle, also known as the 80/20 rule, to their training. That is, 20% of our effort usually produces 80% of our results. In this case, C-sections and endoscopy are the 20% of additional subspecialty training which translate to 80% of added value as a rural American surgeon in 2021. If nothing else, obtain excellent training in these 2 skills.

*Apply early for state licenses, hospital privileges, and insurance credentialing, especially during a pandemic*

Talk about naïve. I received my state license the first week of my start date and thought I was doing great. I am not sure how most people learn about insurance credentialing, but I missed the boat. I recommend that residency programs communicate the importance of this process early to their chief residents. Additionally, I recommend that rural hospitals communicate early and often with their new hires to ensure all credentialing is complete prior to the new surgeon's arrival. Since I was not yet credentialed, I could not independently take call for my first 4 months, and elective referrals were significantly limited for the first third of my inaugural year. I believe the pandemic made this process additionally tedious as my last in-network insurance credentials came in approximately 8 months after their submission.

*A rural surgery training experience may not be sufficient to permit credentialing in a subspecialty procedure*

It was easy in my small town to assume the practice of my partners who were already performing C-section, tonsillectomy, hysterectomy, vasectomy, and endoscopy. Yet, when it came to hospital privileging, my training in rural surgery was not fully understood and accepted for procedures that are not usually part of the "core" of general surgery training. For example, my future partners asked if I could learn to manage kidney stone extraction, and I obtained specific training in this area during residency. However, after my arrival no pathway was available for Focused Professional Practice Evaluation (FPPE) to allow me to manage kidney stones at my hospital, as no one was currently performing ureteroscopy there. I could therefore not be proven competent at this skill. Video proctoring was deemed inadequate. This seemed to be a particularly challenging hurdle to overcome for procedures outside of the usual "general surgery core".

In contrast, I did bring minimally invasive management of varicose veins to our hospital, which was not previously offered. No additional FPPE was required for this procedure as it was included within the "general surgery core" procedures, and currently management of varicose veins is a regular part of my practice.

Family medicine physicians often receive a specific and personalized letter from their program director after completion of residency which describes procedural skills in depth. This letter often details procedures the individual should be expected to "perform independently" or "perform with some proctoring" or "had limited experience" in residency. I strongly recommend rural surgery training programs develop a letter of this nature for all graduating trainees.

As soon as a trainee identifies a practice site, multiple site visits by the trainee should take place and a review of case volumes at the site would be beneficial. More communication is better, and if there are specific subspecialty interests or needs of the surgeon or site, these areas should be aggressively sought out during residency and meticulously documented. Administrative support should be provided to the resident by both their residency and future practice site. For this method to be successful, flexibility in training is required.

### *Existing practice and referral patterns are hard to break*

In spite of my expectations, during my first year I performed no breast or thyroid operations. After further scrutiny, I found that an oncology group from approximately 1.5 hours away had pushed hard for referrals previously, and the majority of breast and thyroid cases were leaving the county.

In contrast, the addition of varicose vein management to my practice was highly successful and relatively quick. To build this practice, I did the following: (1) presented about varicose veins to the primary care physicians at a medical education conference; (2) expressed a desire to referring providers to include treatment of varicose veins in my practice; (3) held a "free varicose vein screening" evening for the community; (4) worked with my hospital to advertise through online and print media; (5) went on the local radio multiple times to promote the practice; and (6) pursued excellence in my practice and communicated back to the primary care physicians by letter on every patient following completion of their care

I did not expect to need to promote breast and thyroid disease in a similar way, but currently I am moving toward this model to inform the referring providers and general public that high quality care for these conditions can be provided close to home.

To the rural surgical trainee, I recommend obtaining detailed case volumes from hospital administration as soon as a practice site is identified. Question these cases, and if there is something remarkably missing that you desire in your practice, find out why. Start planning medical education topics and make sure to communicate well with all primary care doctors that you are an expert with a specific interest in these certain areas. Conversely, it is relatively safe to assume that a procedure which currently is performed at high volumes will be easier to bring into your practice as a new rural surgeon.

### *A rural surgeon often practices at more than one site*

Of the dozens of rural surgeons I know, most work at more than one site. Commonly, surgeons also work for more than 1 employer.

In my black-and-white residency mind, I believed I would practice at my current site for my 4-year contract and then move to my hometown the next county west and establish my independent practice for the rest of my life. Little did I know, I would add locums surgery within 9 months and add my independent practice early, approximately 15 months into my career.

Many staff surgeons in my training had 80:20 contracts where 80% of their time was spent in the Mayo Clinic Health System, and 20% of their time was spent in Rochester, Minnesota at the main Mayo Clinic Hospitals. Other surgeons worked at large tertiary centers but worked one day per week as outreach to smaller hospitals.

Any conceivable practice pattern is a possibility. Working in more than one location benefits the surgeon by increasing adaptability and allowing for higher case volume. There is also a benefit to patients as each practice site may have different strengths which may cause a patient to follow a surgeon to a particular site.

I recommend avoiding non-compete language in contracts as much as possible. Be open and transparent with your communication to hospitals. Recognize that a rural surgeon's financial value to a hospital is based much more in their operating room, laboratory, and imaging utilization than their professional fees alone.

### *The rarest pathology will follow the surgeon to rural America*

My first case was a cholecystectomy and my second an appendectomy. Routine? Wrong. The first was gallbladder cancer and the second was a 9 cm low grade appendiceal mucinous neoplasm.

Preparation by reading and studying is essential. Good relationships with specialists from residency is critical. In my first year I called for advice on a pediatric papillary thyroid cancer, terminal ileitis masking a colon cancer at the ileocecal valve, and rare skin diseases, among other conditions.

The ACS rural surgery list serve and ACS communities have been great resources as well. My recommendation is that rural surgeons engage themselves in state, regional, and national surgical societies and establish friendships to help stay current and fight professional isolation. It is important to attend meetings that are dedicated to rural surgery practice, such as the Northern Plains Surgical Society, which meets in Denver in mid-January each year.

### *Independent practice is alive and well in rural America*

Finally, my professional goal of an independent rural surgical practice is taking shape. Although most surgeons are assuming employed positions, I have successfully started an independent practice in my hometown, while maintaining employment at my initial institution. Time will tell if this model works for me, but the overall ease with which I have established a practice was a pleasant surprise.

### *Conclusion*

In short, rural surgical practice has certain challenges but presents a rewarding, intellectually stimulating career. The recent increased interest in training a broad-spectrum rural surgeon by several novel training tracks is encouraging. Planning for practice is key for rural surgical trainees. Despite the best laid plans, transitioning from residency to practice is likely to expose unexpected realities, but adaptability and an open mind are the best tools for long-term success.

## **Impact of COVID-19 on the rural surgery job market: a personal perspective**

*-Stephanie LeMaster, MD*

When I made the decision to go into medicine, I thought the hardest parts would be getting into medical school, studying for boards, or residency. I assumed that finding a job after completing my training would be easy; there were never enough doctors in the rural area where I was raised. What I had not factored into this was a global pandemic wreaking havoc on the medical system of the country. When I was growing up in a rural area, rural medicine was always an interest to me. Planning for medical school, I thought I would go into family practice and return to the small farming community where I had grown up; however, I quickly decided during my family medicine rotation that primary care was not a good fit for my personality. I rotated on surgery soon after that and fell in love with the specialty. As I was going through residency, I considered doing a fellowship, but eventually I decided that returning to a rural setting as a general surgeon would be more rewarding for me than any fellowship.

As I started my final year of training, I was casually looking at job postings, but I did not feel like I needed to start applying for positions that early. The year prior, one of the chief residents did not start applying until after Christmas and had a signed contract by March, so it did not seem there was a need to rush. What I had not factored was that he was looking for a general surgery job in a pre-pandemic world. My classmates were all doing fellowships, so by the fall, they all knew where they were going to be living and learning, and I was starting to look seriously into applying. I sent out some applications and had a few interviews set up by November, and I was hopeful that I would soon know where I would be living for the foreseeable post-residency future.



My first interview was excellent; I loved the group, and it was in an adorable town. It was my first experience looking for a general surgery job, though, and I wanted to be sure that I looked at a couple of options just to be sure the first place was as perfect as I thought it was. My next interview was at a far less idyllic setting, so I let the first group know I was interested in moving forward. They told me there were a few other applicants who already had interviews, so they would get back to me after those had been completed. That was in early December. Then the second wave of the COVID-19 pandemic set in, and everything ground to a halt. Apparently, the job market impact was felt across surgical specialties.

After the holidays, I was becoming increasingly concerned that finding a job was going to be harder than I had anticipated. I sent out another round of applications and set up more interviews. The second wave of COVID was in full force at this point, and while most people were socially distancing, I was going on multiple flights and meeting tons of new people. I was scared that I would get sick and infect my entire residency, but I needed to find a job, so I wore my mask religiously and kept traveling. I had several more interviews during my second round that seemed promising. I reached out and let people know that I enjoyed my visit and would love to be a part of the team. Some places told me that there were a lot of applicants who applied right after me, so they weren't ready to make a decision yet. Some places did not say anything to me after I left the interview.

COVID started to calm down, the weather became warmer, and I still did not have a clue what I would be doing on July 1. Attendings, medical students, and other residents kept asking what I was doing next year, and I changed my answer from "general surgery" to "moving in with my parents and professionally interviewing." In April, I finally heard back from the very first place that I interviewed: due to the pandemic, they were not going to be able to hire anyone in the near future. Given that it had been 4 months, I had assumed that things were not going to work out for us, but it still set me into a panic. I sent out another round of applications for surgery positions. In May, I started looking at any job opening near my parents' home so that I would at least be able to make payments on my student loans while I continued my marathon job search. I was starting to think that I wasted 5 years of my life training for a specialty that did not want me. I was irritable and moody. I wanted to yell at my co-chief residents who complained about how hard it was to get a medical license or find an apartment for fellowship; I wanted to be complaining with them, but instead I just got to watch them plan for their futures while I was trying to decide if I would want to work at a grocery store or fast-food restaurant to make ends meet.

I continued sending out applications and setting up interviews, but now recruiters were asking why I had waited so long to start applying, that usually they do not have new graduates looking for jobs this late. I assured them that I had been applying and interviewing but the job market was not as friendly as it had been the year before. Finally, on May 26, less than 1 month before I was finished with residency, I had an interview that was successful. I told the group the evening of the interview day that I wanted to work with them, because I was terrified if I waited at all that the opportunity would evaporate. It was finally my turn to look at houses and complain about the medical licensing process in my new home state.

## **Assessing and improving the quality of surgical care in rural hospitals**

*-Mark Puls, MD*

### *Rural patients need high-quality hospitals*

Patients in rural America depend on rural hospitals to provide high-quality surgical care. Seventy-two percent of America's land mass is rural <sup>81</sup>. There are 57 million people, or 17% of the US population, living in rural America.<sup>82</sup>

Access to good medical care can be more difficult in rural America. In a 2018 survey, 23% of responding rural Americans indicated that access to good doctors and hospitals was a major problem in their community.<sup>83</sup> Access to good medical care can become even more difficult for rural patients should their local rural hospital close. A report from 2020 showed that the median distance to an emergency room (ER) increased from 3.3 miles to 24.2 miles following closure of a rural hospital.<sup>84</sup> A 2019 study estimates that 21% of rural hospitals are at high risk of closing due to their financial situation.<sup>85</sup> Between 2013 and 2020, 101 rural hospitals have closed.<sup>83</sup>

### *Assessing the level of surgical quality in rural America*

There are many reports that document very good surgical care being delivered in rural communities. A study by Ibrahim and colleagues compared results of Medicare beneficiaries having one of 4 common surgical procedures (appendectomy, cholecystectomy, colectomy, and hernia repair) at 828 critical access hospitals (CAHs) and 3467 non-CAHs between 2009 and 2013.<sup>86</sup> No statistical difference was found for 30-day mortality rates between CAHs and non-CAHs. CAHs were found to have significantly lower rates of serious complications ( $P < 0.001$ ). Emergency surgery for colectomy was evaluated in another study by Ibrahim and colleagues<sup>87</sup>. They reviewed results of Medicare beneficiaries having an emergency colectomy at CAHs and non-CAHs between 2009 and 2012. Mortality rates at 30 days were lower at CAHs ( $P < 0.01$ ). Lower rates of serious complications were found at CAHs ( $P < 0.01$ ). Patients having an emergency colectomy at a CAH were found to have a higher rate of reoperation and a higher rate of readmission ( $P < 0.01$  for both).

There are also studies showing that the level of care for surgical patients treated in rural hospitals is sometimes suboptimal. In treatment of patients for breast cancer, a lower use of needle biopsy<sup>88</sup> and sentinel lymph node biopsy<sup>89</sup> has been demonstrated for patients treated in rural hospitals. For patients being treated for colon cancer in a rural facility, patients with stage I-III disease were less likely to have 12 or more lymph nodes evaluated compared to patients being treated in an urban facility ( $P < 0.001$ ).<sup>90</sup> The same study showed that rural patients were also less likely to receive adjuvant chemotherapy for stage III colon cancer ( $P < 0.001$ ). This study also showed that, after adjustment for patient factors and tumor stage, patients treated for colon cancer in a rural hospital had a 4% higher risk of death from their colon cancer.

These studies suggest that the level of quality of surgical care can that rural patients receive can vary from hospital to hospital, and probably between surgeon to surgeon. Regardless of the level of care that patients receive in their local rural hospital, there is always room for improvement. Even the best rural hospitals can improve their surgical quality.

### *Surgical quality can be improved*

Surgical quality improvement programs have been shown to be effective in improving surgical quality. The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) is a risk-adjusted, case-mix adjusted program based on 30-day outcomes. The strength of the program is based on its prospective, peer-controlled database, which is composed of clinical data abstracted directly from patients' medical records by trained personnel. Participating hospitals regularly receive reports which allow them to nationally benchmark their complication rates and surgical outcomes, as well as drive quality initiatives in their hospitals.

Many studies have shown that participation in NSQIP can improve surgical morbidity and mortality. A study by Hall and colleagues in 2009 showed that, for hospitals participating in NSQIP, 82% of hospitals improved their complication rates and 66% improved their mortality rates.<sup>91</sup> Cohen and colleagues evaluated surgical outcomes for ACS NSQIP hospitals, and found that, for hospitals that had participated in NSQIP for at least 3 years, 69% showed improvement in mortality, 79% showed improvement in morbidity, and 71% showed

improvement in surgical site infections.<sup>92</sup> In a study by Guillaumondegui and colleagues, surgical outcomes of the Tennessee Surgical Quality Collaborative were reviewed.<sup>93</sup> The 10 hospitals in this collaborative all participated in ACS NSQIP. Over a 2-year time period, statistically significant improvements were noted in rates of surgical site infection, acute renal failure, wound disruption, graft/prosthesis/flap failure, and remaining on a ventilator for longer than 48 hours. A statistically significant increase was noted for pneumonia, deep vein thrombosis (DVT)/thrombophlebitis, and urinary tract infections over the same time period.

### *Quality data alone does not always lead to surgical quality improvement*

It has become apparent that good data alone is not always all that is necessary to lead to improvement in surgical quality. Along with good data, a hospital must have a system in place that can interpret the data, communicate the results effectively, and develop quality improvement methods that lead to effective change in surgical quality. Osbourne and colleagues assessed Medicare patients undergoing one of 11 high risk general surgical or vascular surgical procedures between 2003 and 2012, and compared results from 263 hospitals participating in ACS NSQIP to 526 matched non-ACS NSQIP participating hospitals.<sup>94</sup> There were no statistically significant improvements in outcomes for hospitals at 1, 2, or 3 years after enrollment in ACS NSQIP in risk-adjusted 30-day mortality, serious complications, reoperations, or readmissions when compared to non-ACS NSQIP hospitals.

In recognition that good clinical data alone may not be enough to provide effective change in improving surgical quality, several options have been developed. Multiple surgical collaboratives have been formed. Surgical collaboratives do more than just provide data to hospitals. They provide an opportunity for surgeons and personnel from multiple hospitals to meet regularly in a team-based fashion to review data on surgical quality, discuss best practices on decreasing complications, and formulate quality improvement projects that can improve surgical quality. In a study by Campbell and colleagues, hospitals that participated in the Michigan Surgical Quality Collaborative (MSQC) were found to have a statistically significant decrease in morbidity for patients undergoing general and vascular surgical procedures.<sup>95</sup>

In order to help hospitals to develop a surgical quality improvement program that does more than generate meaningful data, the ACS has developed the ACS Quality Verification Program (ACS QVP).<sup>96</sup> The ACS QVP helps a hospital to develop the culture and infrastructure needed to have an effective surgical quality improvement program that generates meaningful data, analyzes and interprets the data, communicates results effectively, and utilizes the data to drive quality improvement. The ACS QVP can be utilized in a hospital of any size or in multiple hospitals within a system. The ACS QVP is based on the principles of the ACS publication *Optimal Resources for Surgical Quality and Safety*, otherwise known as the "Red Book".<sup>97</sup> The Red Book describes the resources and infrastructure that a hospital needs to develop a successful surgical quality program.

### *How can rural hospitals improve their surgical quality?*

There are several options available to help rural hospitals improve their level of surgical quality. Some rural hospitals choose to develop their own surgical quality improvement program. Other rural hospitals may have the option of participating in a surgical collaborative. Another option is being developed by the ACS. The ACS recognizes the importance of rural hospitals and rural surgeons, and is developing a surgical quality improvement program specifically to meet the needs of rural hospitals of any size, the ACS Rural Surgery Verification Program.

The idea to develop a surgical quality improvement program for rural hospitals originated in the ACS Advisory Council for Surgery (ACRS). ACRS members saw the need to develop a program that would both help rural hospitals to improve their surgical quality, and assure that the underlying resources and infrastructure needed to support high quality surgical services were present

at the rural hospital. At the same time, the ACS was developing the Red Book Program and the ACS QVP. The ACS Rural Surgery Verification Program will incorporate the principles of the ACS QVP to help rural hospitals build a surgical quality improvement program, and will also assure that the resources and infrastructure needed to provide high-quality surgical care are present at the rural hospital.

The ACS Rural Surgery Verification Program contains standards which will help a rural hospital in several areas.

#### *Collect meaningful data*

It is necessary to have good data to be able to assess surgical quality. Rural hospitals will be encouraged to generate some of their own data internally (eg, reviewing operative cases that have an extended OR time, patients that receive an unexpected blood transfusion intraoperatively, or patients that have a return to the OR within 2 weeks of a previous procedure). Data can also be assessed from externally generated sources such as the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), The Joint Commission, The Leapfrog Group, or Healthgrades. Risk-adjusted data, such as those obtained through ACS NSQIP, can be very beneficial but are not required. With good data, a hospital can determine the areas in which it is providing good care for surgical patients and learn where there are opportunities for improvement in patient care.

#### *Develop continuous quality improvement using data*

A major goal of this program is that the rural hospital will utilize their internally and externally generated data to assess their level of surgical quality, determine where improvements are needed, and develop quality improvement projects to address areas of concern. This program can also help a hospital learn to provide more cost-effective care by preventing complications. Hospitals that regularly review and analyze data should be able to establish a cycle of continuous quality improvement.

#### *Develop a surgeon-led team to monitor surgical quality*

Rural hospitals will be encouraged to appoint a Surgical Quality Officer. This person should be a well-respected surgeon that devotes a portion of his/her time to overseeing the program. Team-based solutions to surgical quality problems are accomplished by the development of a Surgical Quality and Safety Committee, which is comprised of all the "decision makers" (eg, surgeons, anesthesia, nursing personnel, and hospital administration) needed to determine and effect change.

#### *Develop a safety culture*

This program will help a rural hospital to develop a hospital-wide culture of safety. Everybody in the hospital should know that providing high quality care to every patient is the primary goal. Reporting systems for safety events are encouraged.

#### *Assure that the resources and infrastructure needed to provide high-quality surgical care are present*

Although not every rural hospital will be able to take care of every surgical patient, a certain level of facility resources, equipment resources, personnel resources, and medical services resources are necessary for surgeons to be able to care for surgical patients. This program will help a rural hospital and its surgeons to evaluate their resources to assure that the necessary resources are available.

#### *Develop effective surgical case review*

This program helps a hospital to develop a standardized process for identifying which surgical cases should be reviewed. Case review should be surgeon-led, and should give surgeons the opportunity to openly discuss adverse events so that surgeons can learn from their mistakes as well as those of their colleagues.

### *Develop effective surgeon review/peer review*

This program helps a hospital to develop a method of doing surgeon-led peer review which is conducted in a confidential, non-biased, and protected format. Investigation of an adverse event should include both the evaluation of the individual surgeon as well as a system-level analysis in attempting to determine the cause of the adverse event. The focus of the peer review process should be for honest inquiry and quality improvement at a system level rather than assigning blame at an individual level.

### *Improve the surgical credentialing and privileging process*

The ACS Rural Surgery Verification Program will assist the rural hospital to develop a credentialing process which assesses the qualifications of surgeons, and a surgical privileging process which designates the specific surgical conditions and procedures that a surgeon will be allowed to manage and perform at the hospital. Surgical leadership at the hospital, such as the Chief of Surgery and the Surgical Quality Officer, should be involved in the credentialing and privileging process.

### *Develop standardized and team-based care for surgical patients*

This program encourages the use of standardized and team-based care through the 5 phases of surgical care (preoperative, immediate preoperative, intra-operative, postoperative, and post-discharge). With standardized and team-based care, there is less chance for error. Preoperative evaluation of patients using the ACS NSQIP Risk Calculator is encouraged. Geriatric patients can be assessed for frailty and optimized for surgery using the ACS Strong for Surgery program. Both the ACS NSQIP Risk Calculator and the ACS Strong for Surgery program can be accessed on the ACS website at no cost. This program encourages the use enhanced recovery after surgery (ERAS) protocols, which can benefit patients postoperatively.

This program is not a "pass/fail" program. Hospitals interested in participating in the ACS Rural Surgery Verification Program should not delay beginning the program because of concern for not meeting some of the standards. At the time of a site visit, hospitals will be asked to provide documentation for the standards they are meeting. For the standards that are not being met, hospitals will be asked to show what they will be doing in the future to meet the standards. Many rural hospitals are already doing activities that meet some of the standards of this program. What is already being done effectively at the rural hospital does not need to be changed. This program will help to coordinate and improve the efforts already being made, and incorporate these efforts into the surgical quality improvement program.

Pilot site visits for this developing program are being conducted virtually. At the conclusion of the site visit, rural hospitals will be given a report detailing their strengths as well as a description of areas where there are opportunities for improvement, along with suggestions of how to achieve this improvement.

At this point, 4 rural hospitals have participated in pilot site visits for this program. There are plans to develop virtual "Open Forum Meetings" in the near future in which surgeons and program leaders from hospitals participating in the program can learn from each other as they discuss problems they encounter and solutions they develop on their journey to continually improve quality. Participating hospitals will have a follow-up site visit every 3 years. A committee of rural surgeons is continuing to work with ACS leadership and staff to further refine and finalize the program standards, with hopes of the ACS Rural Surgery Verification Program becoming an official ACS quality program within 1 year.

To put it simply, the ACS Rural Surgery Verification Program will help a rural hospital to develop a surgical quality improvement program that: (1) generates good data; (2) develops a surgeon-led team to review and analyze the data, which helps a hospital to know what they are doing right, find their own problems, fix their own problems, and prevent them from reoccurring, and drive a cycle of continuous quality improvement for surgical patients; and (3) assures that the hospital has the resources needed to provide high-quality surgical care.

It is clear that patients in rural America depend on their hospitals to provide high-quality surgical care. It is also clear that no matter how good the current level of surgical care is at

a rural hospital, there is always room for improvement. With the right resources, culture, and leadership, rural hospitals can improve their level of surgical quality.

## References

1. Kaufman BG, Thomas SR, Randolph RK, et al. The rising rate of rural hospital closures. *J Rural Health*. 2016;32:35–43.
2. Cromartie J, Dobis EA, Krumel TP, McGranahan D, Pender J. *Rural America at a Glance*. 2020 Edition. Washington, DC: US Department of Agriculture Economic Research Service; 2020.
3. Diaz A, Pawlik TM. Rural surgery and status of the rural workplace. *Surg Clin North Am*. 2020;100:835–847.
4. Christianson JB, Faulkner L. The contribution of rural hospitals to local economies. *Inquiry*. 1981;18(1):46–60.
5. McDermott RE, Cornia GC, Parsons RJ. The economic impact of hospitals in rural communities. *J Rural Health*. 1991;7(2):117–133.
6. Doeksen GA, Loewen RA, Strawn DA. A rural hospital's impact on a community's economic health. *J Rural Health*. 1990;6(1):53–64.
7. Doeksen GA, Johnson T, Biard-Homes D, Schott V. A healthy health sector is crucial for community economic development. *J Rural Health*. 2008;14(1):66–72.
8. Holmes GM, Slifkin RT, Randolph RK, Poley S. The effect of rural hospital closures on community economic health. *Health Serv Res*. 2006;41(2):467–485.
9. Keisler-Starkey K, Bunch LN. *Health Insurance Coverage in the United States: 2019*. Washington, DC: US Census Bureau; 2020.
10. Jones CA, Parker TS, Ahearn M, Mishra AK, Variyam JN. *Health Status and Health Care Access of Farm and Rural Populations*. Washington, DC: Economic Research Service; 2009.
11. Collins SR, Gunja MZ, Aboulafia GN. *US Health Insurance Coverage in 2020: A Looming Crisis in Affordability*. New York, NY: The Commonwealth Fund; 2020 19 August 2020.
12. DeLeire T, Joynk K, McDonald R. *Impact of Insurance Expansion on Hospital Uncompensated Care Costs in 2014*. Washington, DC: Office of the Assistant Secretary for Planning and Evaluation; 2014.
13. Callison K, Walker B, Stoecker C, Self J, Diana ML. Medicaid expansion reduced uncompensated care costs at Louisiana hospitals; may be a model for other states. *Health Aff*. 2021;40(3):529–535.
14. Lindrooth RC, Perraiillon MC, Hardy RY, Tung GJ. Understanding the Relationship Between Medicaid Expansions and Hospital Closures. *Health Aff*. 2018;37(1):111–120.
15. Cunningham PJ, Nichols LM. The effects of medicaid reimbursement on the access to care of medicaid enrollees: a community perspective. *Med Care Res Rev*. 2005;62(6):676–696.
16. Doty B, Zuckerman R, Finlayson S, Jenkins P, Rieb N, Heneghan S. How does degree of rurality impact the provision of surgical services at rural hospitals? *J Rural Health*. 2008;24(3):306–210.
17. Finlayson SRG. Surgery in rural America. *Surg Innov*. 2005;12(4):299–305.
18. Walker JP. Status of the rural surgical workforce. *Surg Clin North Am*. 2020;100:869–877.
19. Aaland MO. Scope of practice of the rural surgeon. *Surg Clin North Am*. 2020;100:861–868.
20. Deal SB, Cook MR, Hughes D, et al. Training for a career in rural and nonmetropolitan surgery—a practical needs assessment. *J Surg Educ*. 2018;75(6):e229–e233.
21. Cohen C, Baird M, Koirola N, Kandrack R, Martsolf G. The surgical and anesthesia workforce and provision of surgical services in rural communities: a mixed-methods examination. *J Rural Health*. 2021;37:45–54.
22. Germack HD, Kandrack R, Martsolf GR. When rural hospitals close, the physician workforce goes. *Health Aff*. 2019;38(12):2086–2094.
23. Cosgrove J. *Rural Hospital Closures: Affected Residents Had Reduced Access to Health Care Services*. Washington, DC: US Government Accountability Office; 2020.
24. Ellison EC, Satiani B, Way DP, Oslock WM, Santry H, Williams TE. The continued urbanization of american surgery: a threat to rural hospitals. *Surgery*. 2021;169:543–549.
25. Ellison EC, Pawlik TM, Way DP, Satiani B, Williams TE. Ten-year reassessment of the shortage of general surgeons: Increases in graduation numbers of general surgery residents are insufficient to meet the future demand for general surgeons. *Surgery*. 2018;164:726–732.
26. Williams TE, Ellison EC. Population analysis predicts a future critical shortage of general surgeons. *Surgery*. 2008;144(4):548–556.
27. Christian Lyngde D, Larson EH, Thompson MJ, Rosenblatt RA, Hart L. A longitudinal analysis of the general surgery workforce in the united states, 1981–2005. *Arch Surg*. 2008;143(4):345–350.
28. Williams TE, Santiani B, Ellison C. A comparison of future recruitment needs in urban and rural hospitals: the rural imperative. *Surgery*. 2011;150(4):617–625.
29. Kelly C, Hulme C, Farragher T, Clarke G. Are differences in travel time or distance to healthcare for adults in global north countries associated with an impact on health outcomes? A systematic review. *BMJ Open*. 2016;6(e013059):1–9.
30. Cyr ME, Etchin AG, Guthrie BJ, Benneyan JC. Access to specialty healthcare in urban versus rural us populations: a systematic literature review. *BMC Health Serv Res*. 2019;19(974).
31. Onge JMS, Smith S. Demographics in rural populations. *Surg Clin North Am*. 2020;100:823–833.
32. The Cecil G. Sheps Center for Health Services Research; Chapel Hill, NC. [https://www.shepscenter.unc.edu/wp-content/uploads/dlm\\_uploads/2017/05/Snapshot2017.pdf](https://www.shepscenter.unc.edu/wp-content/uploads/dlm_uploads/2017/05/Snapshot2017.pdf).
33. Hughes D. *The Role of Community in Midwestern General Surgeons' Practice Location Decisions [Dissertation]*. Kansas City, KS: Health Policy & Management, University of Kansas School of Medicine; 2019.
34. Hughes D, Williams JAR, Brooks JV. Movers and stayers: what birthplaces can teach us about rural practice choice among midwestern general surgeons. *J Rural Health*. 2021;37(1):55–60.

35. Ahmed N, Conn LG, Chiu M, et al. Career satisfaction among general surgeons in Canada: a qualitative study of enablers and barriers to improve recruitment and retention in general surgery. *Acad Med.* 2012;87(11):1616–1621.
36. Brooks RG, Walsh M, Mardon RE, Lewis M, Clawson A. The roles of nature and nurture in the recruitment and retention of primary care physicians in rural areas: a review of the literature. *Acad Med.* 2002;77(8):790–798.
37. Daniels ZM, MOMT MA, VanLeit BJ, Skipper BJ, Sanders ML, Rhyme RL. Factors in recruiting and retaining health professionals for rural practice. *J Rural Health.* 2007;23(1):62–71.
38. Hancock C, Steinbach A, SNesbitt T, Adler SR, Auerswald CL. Why doctors choose small towns: a developmental model of rural physician recruitment and retention. *Soc Sci Med.* 2009;69:1368–1376.
39. Mayo E, Mathews M. Spousal perspectives on factors influencing recruitment and retention of rural family physicians. *Can J Rural Med.* 2006;11(4):271–276.
40. Pathman DE, Konrad TR, Dann R, Koch G. Retention of primary care physicians in rural health professional shortage areas. *Am J Public Health.* 2004;94(10):1723–1729.
41. Pepper CM, Sandefer RH, Gray MJ. Recruiting and retaining physicians in very rural areas. *J Rural Health.* 2010;26(2):196–200.
42. Shannon CK. A community development approach to rural recruitment. *J Rural Health.* 2003;19(5):347–353.
43. Fu SJ, George EL, Maggio PM, Hawn M, Nazerali R. The consequences of delaying elective surgery: surgical perspective. *Ann Surg.* 2020;272(2):e79–e80.
44. Meredith JW, High KP, Freischlag JA. Preserving Elective surgeries in the COVID-19 pandemic and the future. *J Am Med Assoc.* 2020;324(17):1725–1726.
45. Vogler J. Rural hospital closures and local economic decline. [Working Paper]. 2020; Available at: <https://drive.google.com/file/d/13JKT0ePIRhbIMQZ6IKc2dFDdUCT2o0-/view>. Accessed September 3, 2021.
46. COVID-19 pandemic results in bankruptcies or closures for some hospitals. [Fact Sheet]. 2020; Available at: <https://www.aha.org/system/files/media/file/2020/11/fact-sheet-covid-hospital-bankruptcies-1120.pdf>. Accessed September 4, 2021.
47. Christensen J. How the pandemic killed a record number of rural hospitals. [Online Article]. 2021; Available at: <https://www.cnn.com/2021/07/31/health/rural-hospital-closures-pandemic/index.html>. Accessed September 4 2021.
48. Rural Advocacy Agenda. [Fact Sheet]. 2021; Available at: <https://www.aha.org/system/files/media/file/2021/02/2021-rural-advocacy-agenda.pdf>. Accessed September 4, 2021.
49. University of North Carolina. Rural Hospital Closures. 2021. Available at: <https://www.shepscenter.unc.edu/programs-projects/rural-health/rural-hospital-closures/>. Accessed August 11, 2021.
50. Doeksen GA, St. Clair CF, Eilrich FC, et al. Economic Impact of Rural Health Care. October 2016. Available at: <http://ruralhealthworks.org/wp-content/uploads/2018/04/Summary-Economic-Impact-Rural-Health-FINAL-100716.pdf>. Accessed August 11, 2021.
51. Harris JD, Hosford CC, Sticca RP, et al. A comprehensive analysis of surgical procedures in rural surgery practices. *Am J Surg.* 2010;Dec;200(6):820–825; discussion 825–6.
52. Aaland MO. Scope of practice of the rural surgeon. *Surg Clin North Am.* 2020;100(5):861–868.
53. Sticca RP, Mullin BC, Harris JD, Hosford CC. Surgical specialty procedures in rural surgery practices: implications for rural surgery training. *Am J Surg.* 2012;204(6):1007–1013 Issues that face.
54. Deal SB, Cook MR, Alseidi AA, et al. Training for a career in rural and nonmetropolitan surgery – a practical needs assessment. *J Surg Educ.* 2018;75(6):229–233.
55. Klingensmith ME, Cogbill TH, Luchette F, et al. Factors influencing the decision of surgery residency graduates to pursue general surgery practice versus fellowship. *Ann Surg.* 2015;Sep;262(3):449–455; discussion 454–5.
56. Mercier PJ, Skube SJ, Leonard SL, et al. Creating a rural surgery track and a review of rural surgery training programs. *J Surg Educ.* 2019;76(2):459–468.
57. Deveney K, Hunter J. Education for rural surgical practice: The Oregon Health & Science University model. *Surg Clin North Am.* 2009;89(6) 1303–viii. Mercier.
58. Timmerman GL, Thambi-Pillai TC, Johnson MK, et al. Initial and ongoing training of the rural surgeon. *Surg Clin North Am.* 2020;100(5):849–859.
59. Avery DM, Wallace JC. Rural surgery training programs in the United States: a review of the literature. *Online J Rural Res Policy.* 2016;11(3):1–20.
60. The American Board of Surgery. Training and certification: flexible rotations during residency. 2021. Available at: <https://www.absurgery.org/default.jsp?policyflexrotations>. Accessed August 11, 2021.
61. Rossi IR, Rossi MB, McLaughlin E, et al. Rural surgical training in the United States: delineating essential components within existing programs. *Am Surg.* 2020;86(11):1485–1491.
62. Patterson DG, Andrilla CHA, Garbersen LA, et al. Preparing physicians for rural practice: availability of rural training in rural-centric residency programs. *J Grad Med Educ.* 2019;11(5):550–557.
63. VU Perl, Diggs B, Ham B, et al. Does surgery residency prepare residents to work in critical access hospitals. *Am J Surg.* 2015;209(5):828–833.
64. Linn JG, Hungness ES, Clark S, et al. General Surgery training without laparoscopic surgery fellows: the impact on residents and patients. *Surgery.* 2011;150(4):752–758.
65. Petrushenko W, Perry W, Fraser-Kirk G, et al. The impact of fellowships on surgical resident training in multidisciplinary cohort in Australia and New Zealand. *Surgery.* 2015;158(6):1468–1474.
66. Rossi AN, Rossi DC, Rossi MB, et al. Continuity of care in a rural critical access hospital: surgeons as primary care providers. *Am J Surg.* 2011;201(3):359–362.
67. Doty B, Zuckerman R. Rural surgery: framing the issues. *Surg Clin North Am.* 2009;89:1279–1284.
68. Ellison EC, Satiani B, Way DP, Oslock WM, Santry H, Williams TE. The continued urbanization of American surgery: a threat to rural hospitals. *Surgery.* 2021;169:543–549.
69. Shively EH, Shively SA. Threats to rural surgery. *Am J Surg.* 2005;190(2):200–205 PMID: 16023431. doi:10.1016/j.amjsurg.2005.05.012.

70. Cheadle WG, Franklin GA, Richardson JD, Jr Polk HC. Broad-based general surgery training is a model of continued utility for the future. *Ann Surg.* 2004;239(5):627–636. doi:10.1097/01.sla.0000124384.08410.94.
71. Roskos Michael, Nelson Megan. Regionalization of general surgery within the mayo clinic health system and the mayo clinic. *Surg Clin North Am.* 2020;100(5):937–948 Issue.
72. Stain SC, Cogbill TH, Ellison EC, et al. Surgical training models: a new vision. Broad-based general surgery and rural general surgery training. *Curr Probl Surg.* 2012;49(10):565–623 PMID: 22967484. doi:10.1067/j.cpsurg.2012.06.008.
73. Rossi I, Rossi M, McLaughlin E, et al. Rural surgical training in the United States: delineating essential components within existing programs. *Am Surg.* 2020;86(11):1485–1491 Epub 2020 Oct 30. PMID: 33125284. doi:10.1177/0003134820964203.
74. Lehman RC, Douglass BG, Heller SF, Roskos MC. Mayo Clinic joins the national effort to train tomorrow's rural surgeons. *Bullet Am Coll Surg.* 2019;104(10):33–38.
75. Michael Ratcliffe, Charlynn Burd, Kelly Holder, Alison Fields, “ Defining Rural at the U.S. Census Bureau,” ACSGEO-1, U.S. Census Bureau, Washington, DC, 2016.
76. Stinson Jr WW, Sticca RP, Timmerman GL, Bjordahl PM. Current trends in surgical procedures performed in rural general surgery practice. *Am Surg.* 2021;87(7):1133–1139 Epub 2020 Dec 18. PMID: 33338387. doi:10.1177/0003134820947390.
77. Decker MR, Dodgion CM, Kwok AC, et al. Specialization and the current practices of general surgeons. *J Am Coll Surg.* 2014;218(1):8–15. doi:10.1016/j.jamcollsurg.2013.08.016.
78. Harris JD, Hosford CC, Sticca RP. A comprehensive analysis of surgical procedures in rural surgery practices. *Am J Surg.* 2010;200(6):820–825 discussion 825–6PMID: 21146027. doi:10.1016/j.amjsurg.2010.07.029.
79. Larson EH, Andrilla CHA, Kearny J, Garberson LA, Patterson DG. The distribution of the general surgery workforce in rural and urban America in 2019. Policy Brief. WWAMI Rural Health Research Center, University of Washington; 2021.
80. Deal SB, Cook MR, Hughes D, et al. Training for a career in rural and nonmetropolitan surgery—a practical needs assessment. *J Surg Educ.* 2018;75(6):e229–e233 Epub 2018 Aug 10. PMID: 30100324. doi:10.1016/j.j Surg.2018.07.013.
81. Rural economy and population: Population and migration. U.S. Department of Agriculture Economic Research Service mail website. Available at: <https://www.ers.usda.gov/topics/rural-economy-population/population-migration/>. Accessed August 6, 2021.
82. Size of urban and rural population of the United States from 1960 to 2020. Statista mail website. Available at: <https://www.statista.com/statistics/985183/size-urban-rural-population-us/>. Accessed August 6, 2021.
83. How far Americans live from the closest hospital differs by community type. Pew Research Center mail website. Available at: <https://www.pewresearch.org/fact-tank/2018/12/12/how-far-americans-live-from-the-closest-hospital-differs-by-community-type/>. Accessed August 6, 2021.
84. Rural hospital closures: Affected residents had reduced access to health care services. U.S. Government Accountability Office mail website. Available at: <https://www.gao.gov/products/gao-21-93>. Accessed August 6, 2021.
85. Rural Hospital Sustainability. Guidehouse mail website. <https://guidehouse.com/insights/healthcare/2019/rural-hospital-sustainability>. Available at: Accessed August 6, 2021.
86. Ibrahim AM, Hughes TG, Thumma JR, Dimick JB. Association of hospital critical access status with surgical outcomes and expenditures among Medicare beneficiaries. *JAMA.* 2016;315(19):2095–2103.
87. Ibrahim AM, Regenbogen SE, Thumma JR, Dimick JB. Emergency surgery for medicare beneficiaries admitted to critical access hospitals. *Ann Surg.* 2018;267(3):473–477.
88. Zimmerman CJ, Sheffield KM, Duncan CB, et al. Time trends and geographic variation in use of minimally invasive breast biopsy. *J Am Coll Surg.* 2013;216(4):814–824.
89. Arrington AK, Kruper L, Vito C, et al. Rural and urban disparities in the evolution of sentinel lymph node utilization in breast cancer. *Am J Surg.* 2013;206(5):674–681.
90. Chow CJ, Al-Reraie WB, Abraham A, et al. Does patient rurality predict quality colon cancer care?: a population-based study. *Dis Colon Rectum.* 2015;58(4):415–422.
91. Hall BL, Hamilton BH, Richards K, Bilimoria KY, Cohen ME, Ko CY. Does surgical quality improve in the American College of Surgeons National Surgical Quality Improvement Program: an evaluation of all participating hospitals. *Ann Surg.* 2009;250(3):363–376.
92. Cohen ME, Liu Y, Ko CY, Hall BL. Improved surgical outcomes for the ACS NSQIP hospitals over time: evaluation of hospital cohorts with up to eight years of participation. *Ann Surg.* 2016;263(2):267–273.
93. Guillamondegui OD, Gunter OL, Hines L, et al. Using the national surgical quality improvement program and the tennessee surgical quality collaborative to improve surgical outcomes. *J Am Coll Surg.* 2012;214(4):709–714.
94. Osborne NH, Nicholas LH, Ryan AM, Thumma JR, Dimick JB. Association of hospital participation in a quality reporting program with surgical outcomes and expenditures for Medicare beneficiaries. *JAMA.* 2015;313(5):496–504.
95. Campbell DA, Englesbe MJ, Kubus JJ, et al. Accelerating the pace of surgical quality improvement: the power of hospital collaboration. *Arch Surg.* 2010;145(10):985–991.
96. The ACS Quality Verification Program. American College of Surgeons mail website. Available at: <https://www.facs.org/quality-programs/quality-verification>. Accessed August 9, 2021.
97. Hoyt DB, Ko CY, eds. *Optimal Resources for Surgical Quality and Safety*. Chicago, IL: American College of Surgeons; 2017.