DRAFT

The Economic Impact of a Rural General Surgeon

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Funded by Federal Office of Rural Health Policy,
DHHS, and Health Resources and Services Administration

April 2010

THE ECONOMIC IMPACT OF A RURAL GENERAL SURGEON

Converging forces are contributing to declines in the availability of rural general surgery services. A developing crisis will have profound impacts on many rural residents, hospitals, physicians and communities. While most rural communities' attention is predominately directed to assuring primary medical care availability, more specific focus must be directed to general surgery and its interconnectedness with the sustainability of primary care and other rural services.

Without substantive intervention over the next several years, rural residents will experience unnecessary barriers to access, travel greater distances, and may not receive timely acute care. There will be more unnecessary and costly emergency transports to larger facilities. In many settings, patients will defer preventive care (e.g., colonoscopies). In some cases, they will confront compromised quality due to the skill mix of some replacement providers recruited in desperation and/or volumes that fall below quality guidelines. [**1**]

With the declines in locally provided general surgery services, Critical Access Hospitals and other rural hospitals will experience a reduction in revenues and operating margins. This will increasingly limit their ability to cross-subsidize programs that are not financially self-sustaining. Declines in surgeon revenue will weaken support for primary care in many locations. In rural areas, this will significantly undermine the healthcare safety-net.

The erosion of surgical services may result in a loss of community confidence in other local care, greater patient migration, and further losses of non-surgical revenue critical to sustaining rural hospitals. In such cases, rural health care systems will falter and may collapse with notable negative impacts on access, quality, jobs and local economies.

The depth of the developing crisis is likely to be profound. While the scope of the issues is broad, the focus of this study is addressing the economic impact of a rural general surgeon on a rural community and on advancing a methodology for estimating surgeon need.

Typically, rural residents pay little attention to their health care systems until they risk losing them. As a result, many people are unaware of the importance of the health care system on the economies of the local communities. The employment opportunities and resulting wages and salaries make the health care system an extremely important part of the local economy. Research from the National Center for Rural Health Works indicates that between ten and fifteen percent of the jobs in many rural counties are in the health care sector. Hospitals often are the second largest employer in rural counties trailing only local school systems [**2**].

Previous studies on rural surgery have outlined challenges that deserve additional investigation, such as the economic contribution of surgery to small rural hospitals and mechanisms to identify an adequate surgical workforce [**3**]**.** Eilrich, et al. detailed the importance of a primary care physician to a rural health care system [**4**]. There is much debate regarding the available supply of trained rural general surgeons [**5, 6**]**,** but this is a topic for other research.

The study is divided into two sections:

1. Estimation of the benefits generated by a rural general surgeon;

- employment and income generated by a surgeon's practice;
- employment and income generated by a surgeon in the hospital from inpatient and outpatient services; and
- secondary employment and income created in the community from the general surgeon's office and hospital practice.

2. Discussion of methodology to estimate the potential need for a rural general surgeon;

- constructing national age and gender specific coefficients for general surgery procedures;
- estimating number of procedures based on demographics of medical service area; and
- determining number of general surgeons required to meet need in a specific community.

The potential risk of losing a general surgeon in a rural hospital represents a substantive economic loss, and a faltering surgical program can represent incremental losses that may ultimately contribute to program failures. Conversely, the ability to expand general surgery represents a potential increase in hospital revenues and local health expenditures by recapturing dollars lost when health services are not purchased locally. While this study predominately focuses on the risk of losing general surgery, the potential gains may be considerable.

Patients who go elsewhere for general surgery are more likely to bypass local services for their other medical services as well. The loss of emergency department related volume can affect not only revenues, but community perceptions of local quality as well. Additional dollars will be captured in the community when surgery services are provided locally because purchases of related goods and services also occur. Typical related goods and services are those associated with laboratories, diagnostic imaging and pharmacies. A 2006 survey in Louisiana found that over 90 percent of the patients who went out of town to visit a specialist also had their lab work at the specialist's location **[7].**

The Economic Contributions of a Rural General Surgeon

While variable from community to community, rural general surgeons provide fundamental services in rural America. The ability to provide needed medical services in rural areas is obvious, but the economic contribution to the rural economy is typically less known.

The availability of adequate medical services is essential for maintaining a healthy community. It is also critical for economic development. Business and industry will not locate in a community without quality health services. Likewise, retirees looking for retirement locations place a heavy emphasis on quality health services. A strong health care system that includes a general surgeon provides medical benefits as well as economic benefits. A large portion of the revenues generated by a rural general surgeon are returned to the local community. The surgical services create employment opportunities for surgical support personnel and other professional office staff which provide incomes, much of which are in turn spent locally. This personal spending, along with hospital and office practice purchases of goods and services from other local and regional businesses, stimulates economic growth in many other parts of the economy. As these dollars continue to be spent locally, the multiplier effect associated with a surgeon's practice becomes clear. Much of this economic activity generates additional tax revenues (e.g., sales, property, excise and income) to be used by the local and state government to fund important community services, including state Medicaid programs.

The first section of this study estimates the economic value that a rural general surgeon provides in an office practice and as inpatient and outpatient revenue for a typical critical access hospital and rural community. Nonetheless, the relative paucity of available data underestimates the total value of a general surgeon because the impact on other sectors such as pharmacy and

nursing homes, emergency departments, primary care practices and diagnostic imaging are not included.

Direct Impacts of a General Surgeon

Data in **Table 1** present typical direct impacts that a general surgeon's office practice creates. In addition to the surgeon, employment opportunities for practice associated staff are created along with corresponding wages and salaries. Based on discussions with several general surgeons, a typical general surgeon practice has three full-time employees. Therefore, the total employment impact including the surgeon would be four jobs. The average nonmetropolitan wage and salary estimates for practice staff were obtained from the U.S. Bureau of Labor Statistics for Oklahoma, Indiana and Virginia [**8**]. The 2008 Medical Group Management Association (MGMA) Physician Compensation and Production Survey provided average wage estimates for a nonmetropolitan general surgeon. The direct impact for these four jobs totaled $483,082 which includes 25 percent for benefits [**9**]**.** This estimate includes earnings and benefits for a general surgeon, a registered nurse, medical assistant and a receptionist. The 2008 MGMA Cost Survey for Specialty Physician provided estimates for total annual revenues from a single general surgeon practice [**10**]**.** Total 2008 national average practice revenue was $653,544. **Table 1** does not reflect the full costs of an office practice as it does not include direct and indirect non-employment practice expenses.

The direct impacts that a general surgeon has on the hospital are shown in **Table 2**. Specialty physician services such as general surgery can significantly impact the financial stability of the hospital [**11**]. In addition to inpatient visits, general surgeons generate significant outpatient activity that increases hospital net revenue.

Table 1
2008 Estimated Employment, Wage and Salaries and Revenues
at General Surgeon Practice

Employment		4
Wages, and Salaries		
General Surgeon	$288,126	
Registered Nurse	$52,421	
Medical Assistant	$25,605	
Receptionist/Bookkeeper	$21,313	
Total Wages and Salaries	$386,465	
Benefits (25%)	$96,617	
TOTAL Wages Salaries and Benefits		$483,082
Revenues		$653,544

Eight Oklahoma hospitals, along with one Indiana hospital and one Virginia hospital were surveyed to collect data regarding their general surgery programs. The surveyed hospitals had established general surgery programs and represented rural hospitals. From these surveys, data showed that on average, a rural general surgeon generates 97 inpatient procedures ranging from 40 to 180 and 574 outpatient procedures per year ranging from 182 to 935.

According to survey data, 2008 average revenue collected per inpatient procedure was estimated at $3,611. The estimated total hospital revenue attributed to general surgery inpatient procedures was $350,267 (97 x $3,611). The additional net revenue from outpatient activity can vary among general surgeons. The average hospital revenue per outpatient surgical procedure was approximately $1,616 making estimated outpatient revenue from 574 procedures of $927,584. The average revenue collected by the hospital from additional laboratory and diagnostic procedures totaled $60,842. In total based on these estimates, a general surgeon will generate $1,338,693 for the hospital from his/her patient activity.

Table 2
General Surgery Procedures, Revenues, Employment and Wage and Salaries at the Hospital Generated by a General Surgeon

No. of Inpatient Procedures	97
No. of Outpatient Procedures	574
Inpatient Revenue	$350,267
Outpatient Revenue	$927,584
Laboratory Revenue	$60,842
TOTAL Revenue	$1,338,693
Employment	15.0
Wage, Salary and Benefits	$697,459

Source: Local data from ten rural communities

As noted, revenue generated by general surgeons supports hospital employment and generates payroll. The hospital survey data were used to estimate the number of hospital employees and wages and salaries that were generated from patient revenue. First, average total employment costs (including benefits) were estimated from total net revenue. An estimated 52.1 percent of hospital revenues were spent on wages and salaries including benefits. Therefore, wage, salary and benefits at the hospital generated from surgeon activity are estimated to total $697,459 ($1,338,693 x 0.521). Average cost per employee was $46,548 resulting in direct hospital employment of 15.0 ($697,459/$46,548) full-time equivalent employees.

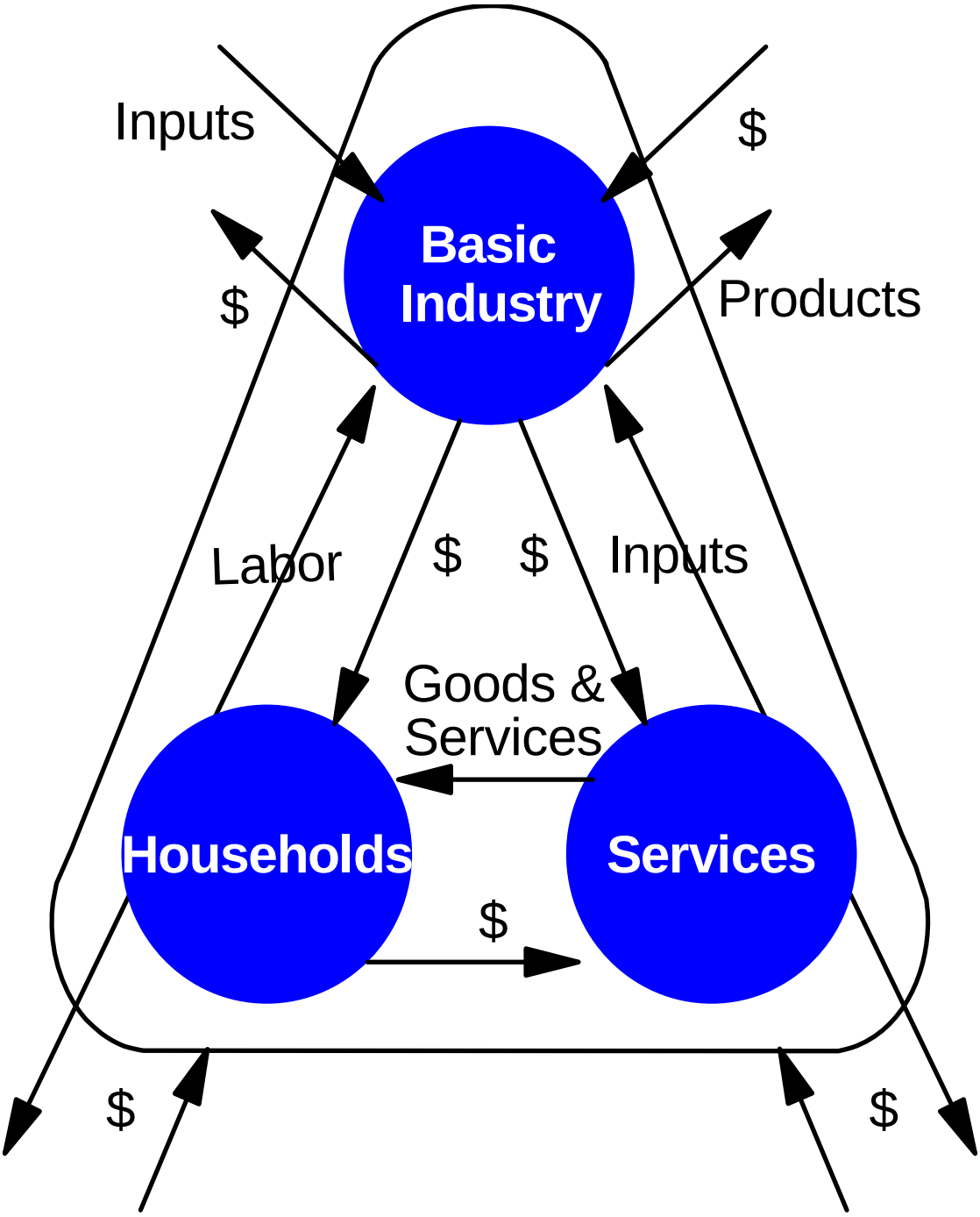
The Multiplier Effect

Direct jobs and wages and salaries further benefit the community through increased jobs and income. As the surgeon office, hospital and the medical staff purchase goods and services, additional employment and income are created in other businesses. The additional employment and income can be calculated with an input-output model and computer generated data from IMPLAN. This computer model and data are explained in more detail in **Appendix A**.

The concept is depicted in **Figure 1**, which illustrates the major flows of goods, services, and dollars from a basic industry. The basic industry, in this case the general surgeon office or hospital, purchases inputs from outside the community (upper left portion of **Figure 1**), labor from the residents or "households" of the community (left side of **Figure 1**), and inputs from service industries located within the community (right side of **Figure 1**). Households using their earnings to purchase goods and services from the community's service industries complete the flow of labor, goods, and services in the community. The relationships illustrated in **Figure 1** show that a change in any one segment of a community's economy will cause reverberations throughout the entire economic system of the community. These reverberations, known as multipliers in economic terms, are estimated based on historic linkages between industries and vary at the county level.

Total Contribution Including Secondary Impacts

Data in **Table 3** present the total impacts of the general surgery office practice and related business that a typical general surgeon brings to a local hospital. For this analysis, average multipliers for the surveyed rural communities are utilized. The output multiplier indicates how this revenue moves through a local economy. For example, the office practice revenue multiplier of 1.33 estimates that for every $1 of revenue collected by the practice, another $0.33 is generated by other businesses in the community due to local purchases made by the office practice and its employees. **Table 1** showed that the revenue to the office practice was $653,544. The total revenue impact of the general surgery office ($869,214) is shown in **Table 3**. The same methodology used for the hospital yields $1,780,462 of revenue generated throughout the community. The total revenue generated from the practice and the hospital is $2,649,676.



Community Economic System
Figure 1

Using the employment and payroll data from **Tables 1** and **2,** an estimate of total income and employment created from the general surgeon practice and hospital procedures was made. The general surgeon will generate an estimated $1,413,961 in income (wages, salaries and benefits) in the community and create 25.8 jobs throughout the community. Again, the estimate is low because the impact measures only the impacts from the practice and hospital and does not include impacts from the hospital and local pharmacies.

Table 3
Total Impact of a General Surgeon on Revenues, Income and Employment at Physician Office and Hospital[1]

	Revenue	Output Multiplier	Total Impact
Office	$653,544	1.33	$869,214
Hospital	$1,338,693	1.33	$1,780,462
Total	**$1,992,237**		**$2,649,676**
	Income	Income Multiplier	Total Impact
Office	$483,082	1.18	$570,036
Hospital	$697,459	1.21	$843,925
Total	**$1,180,541**		**$1,413,961**
	Employment	Employment Multiplier	Total Impact
Office	4.0	1.30	5.2
Hospital	15.0	1.37	20.6
Total	**19.0**		**25.8**

[1] Income includes wages, salaries and benefits.
Source: 2007 IMPLAN database, Minnesota IMPLAN Group, Inc., Local data from ten rural communities

This report clearly documents the economic importance of a general surgeon to a hospital and a community. The surgeon generates approximately $2.6 million in revenue, $1.4 million in payroll and creates 26 jobs. The relatively large impact is created through

surgeon practice employment, inpatient/outpatient procedures as well as additional laboratory/diagnostic tests at the hospital and the multiplier effect of these contributions. Thus, in addition to a surgeon's clinical contributions, the *economic* contributions are critically important. It is beyond the scope of this study, but to the extent that surgical services has collateral effects on other services such as emergency department and primary medical care associated volumes, the estimated economic impacts will be much greater than those associated with just the general surgeon. The economic risks of losing a surgeon are much greater than those traditionally seen by only looking at the surgeon's direct revenue.

Estimating Potential Local General Surgeon Visits

There are several approaches to estimating the number of general surgeons for a medical service area. Population-based need has been suggested as the best tool for planning purposes and will be used here [**12**]. A need-based approach estimates the number of potential procedures performed by a general surgeon by constructing age- and gender-specific coefficients and applying them to a specific service area population. To construct the coefficients, public use data files were obtained from two National surveys, the National Hospital Discharge Survey (NHDS) and the National Survey of Ambulatory Surgery (NSAS). Both surveys are conducted periodically by the National Center for Health Statistics.

The NHDS is conducted annually and covers discharges from noninstitutional hospitals, excluding Federal, military and Veterans Administration hospitals, located in the 50 States and the District of Columbia [**13**]. Only short-stay hospitals (hospitals with an average length of stay for all patients of less than 30 days) or those whose specialty is

general (medical or surgical) or children's general are included in the survey. In 2006, 501 hospitals were surveyed and 438 hospitals responded.

The NSAS covers ambulatory surgery procedures performed in hospitals and freestanding ambulatory surgery centers in the United States [**14**]. NSAS uses the same hospital selection criteria used by the NHDS. In 2006, 224 hospitals were surveyed with 142 hospitals responding. The data have several variables detailing each recorded event including age and gender of patient and procedure identification using the International Statistical Classification of Disease (ICD-9) [**15**] coding system along with other variables such as symptoms, diagnoses, length of stay, provider type, etc. Both data sets were edited to correct and/or account for sampling errors and each record was weighted to project national or regional estimates.

Defining Rural General Surgery Programs

Frequently, visits to a general surgeon take place in larger urban facilities located in metropolitan areas. Although many rural hospital service areas do not have sufficient population to support a full-time equivalent (FTE) general surgeon, the demand for a general surgeon is quite often enough to support a part-time surgeon. However, in many hospital communities, the need for a partial FTE surgeon is a conundrum. Additional FTEs must be employed to enable call coverage even though population and utilization is insufficient to support them. There are numerous complications related to economic sustainability of such services. It is cautionary to note that such needs that extend beyond the "numbers" are real and the demand for rural general surgeons often exceeds the direct clinical and economic needs.

The field of general surgery is very broad based and the types of procedures performed by general surgeons can vary dramatically by surgeon and by hospital [**16**]. Some definitions are simply not very helpful. For example, the following is part of a job description for a general surgeon provided by one business specializing in training and educational materials for health care professionals:

> A general surgeon works with a variety of instruments with a variety of patients under many different conditions [**17**].

More helpful is the American Board of Medical Specialties definition of a general surgeon as:

> …having expertise in the diagnosis and care of patients with diseases and disorders affecting the abdomen, digestive tract, endocrine system, breast, skin and blood vessels. Common problems treated by general surgeons include hernias, breast tumors, gallstones, appendicitis, pancreatitis, bowel obstructions, colon inflammation and colon cancer. General surgeons increasingly provide care through the use of minimally invasive and endoscopic techniques [**18**].

The American College of Surgeons adds:

> General surgeons often set the standard of surgical care in a community. "We choose the procedures we feel most comfortable with to provide services for our patients." When patients are referred for advanced medical intervention, general surgeons are commonly the only members of the local medical staff familiar with the procedure performed or management required [**19**].

Furthermore, previous research indicates that the scope of urban and rural general surgical procedures is often markedly different **[20, 21].** Therefore, it is difficult to identify a single definition that would uniquely describe every rural general surgeon or the routine procedures that they perform. Experience, personal preference and/or subspecialty training will impact the types of procedures that general surgeons will perform on a routine basis. For example, some general surgeons will perform

gynecological procedures while others will not. Many rural hospitals do not deliver babies and therefore procedures on infants would be limited to only unique emergencies. A hospital's proximity relative to a nearby surgical center or alternative specialist will also impact the type of surgery procedures performed. General surgeons in some communities perform orthopedic procedures such as knee arthroscopy, although such care in increasingly an outlier. To create a list of procedures that represents the practice patterns of every general surgeon or every rural general surgeon is impossible. Thus, we must look to averages of typical procedures.

Procedure to Estimate Potential Annual General Surgery Procedures

To estimate the need for local general surgery services, typical procedures performed by rural general surgeons were identified. A methodology was created to estimate the annual rate of these procedures by age and gender. The list of procedures presented in **Table 4** was compiled from the ten sampled hospitals. The goal was to compile a condensed list of procedures that were routinely performed by rural general surgeons. The task proved difficult, because even though the surveyed hospitals were similar in size and operations, the procedure data were not common to all ten hospitals. For the purpose of illustrating the methodology, only those procedures that were performed more than one time during the year were included for this analysis. The procedure codes were obtained from ICD-9-CM (FY07) classification of procedures list to correspond with the national survey data. As noted earlier, procedure volume and scope of practice can vary dramatically. Research on general surgeons in North Carolina found that one-quarter of the rural general surgeons performed less than 275 procedures and one-quarter performed more than 783 procedures. Results also indicated that the

Table 4
Potential List of General Surgery Procedures Performed by Rural General Surgeons[1]

04.43	CARPAL TUNNEL RELEASE	45.42	ENDOSCOPIC POLPECTOMY LARGE INT	68.23	ENDOMETRIAL ABLATION
08.20	REMOVE EYELID LESION	45.73	RIGHT HEMICOLECTOMY	68.49	OTHER TOTAL HYSTERECTOMY
08.87	UPPER LID RHYTIDECTOMY	47.01	LAP APPENDECTOMY	69.09	DIAGNOSTIC D & C
13.41	CATARACT PHACOEMULSIFICATION	47.09	OTHER APPENDECTOMY	83.31	TENDON LESION EXCISION
20.09	OTHER MYRINGOTOMY	48.36	POLYPECTOMY OF RECTUM	85.21	BREAST LESION EXCISION
28.3	TONSILLECTOMY/ADENOIDECTOMY	51.23	LAP CHOLECYSTECTOMY	85.43	UNILATERAL SIMPLE MASTECTOMY
34.91	THORACENTESIS	53.41	UMBILICAL HERNIA REPAIR	86.04	OTHER SKIN DRAINAGE
37.83	INSERT DUAL-CHAMBER PACE MAKER	53.61	ABDOMINAL HERNIA REPAIR	86.07	INSERTION VAD
42.92	ESOPHAGEAL DILATION	53.69	OTHER ABDOMINAL HERNIA REPAIR	86.21	EXCISION PILONIDAL LESION
43.11	PERCUTANEOUS ENDOSC GASTROSTOMY	54.21	LAPAROSCOPY	86.3	OTHER EXCISION OF SKIN LESION
45.13	OTHER SMALL INT. ENDOSCOPY (EGD)	57.32	OTHER CYSTOSCOPY	86.4	RADICAL EXCISION SKIN LESION
45.16	EGD WITH CLOSED BIOPSY	57.33	TRANSURETHAL BLADDER BX	98.51	ESWL KIDNEY/URETER/BLADDER
45.23	COLONOSCOPY	59.71	LEVATOR MUSCLE SUSPENSION		
45.24	FLEXIBLE SIGMOIDOSCOPY	66.29	OTHER ENDOSCOPIC FALLOPIAN TUBE		
45.25	ENDOSCOPIC LARGE INT. BIOPSY	68.12	HYSTEROSCOPY		

1Based on procedures sampled from general rural hospital general surgery programs

scope of practice for rural general surgeons was significantly diverse ranging from less than 30 different procedures to well over 70 [**16**]. It is especially important to recognize that this list does not in any way represent the limit of what is possible and appropriate in rural hospitals, but rather serves as a starting point for planning purposes.

Both the NHDS and NSAS data files were queried to obtain all the records that corresponded to the final list of procedures. A statistical software package was utilized to estimate national coefficients from the sample. Data in **Table 5** present the potential number of annual general surgery procedures by specified age and gender. For instance, for every 1,000 males between the ages of 45 and 64, the average annual number of specified general surgery procedures was 82.4. Utilization rates per capita in rural areas might be slightly different than the national average. However, in the absence of specific rural data, these national coefficients can serve as the best approximations available.

Application of Predicted Surgery Coefficients

To illustrate the use of these coefficients, the population estimates by age and gender were obtained from the U.S. Census Bureau for an example medical service area (population 7,677) which typifies a rural community (**Table 6**). The average annual visit rates from **Table 5** are applied to estimate the potential number of specified general surgery procedures performed in the medical service area. The results are presented per 1,000 populations in **Table 7**. For example, the 1,022 males in the medical service area between the ages of 45 and 64 will require 84 general surgery procedures (1.022 x 82.4). Females in the same age group are estimated to require 115 general surgery procedures. All the residents in the medical service area (7,767) are estimated to make 525 total general surgery procedures per year.

This methodology can be applied to estimate the need for a general surgeon based on the demographics of the medical service area. The list of procedures can be adapted to represent a particular general surgeon or hospital scenario. From these estimates, a hospital administrator can assess the need for a general surgeon and estimate the required FTEs necessary to meet the demand. **Table 8** summarizes the results for the example community. One quick approach to identifying the need for a general surgeon is to apply national averages to the total population of the medical service area. For example,

Table 5
Annual General Surgeon Procedures by Age and Gender[1]

Age	Procedure Rate per 1000	
	Male	Female
Under 15	14.8	14.2
15-44	18.7	42.3
45-64	82.4	106.3
65-74	180.8	195.0
75+	191.6	167.2

[1]Data based on procedures sampled from rural hospitals
Source: The 2006 National Hospital Discharge Survey and 2006 National Survey of Ambulatory Surgery, 2008 Census estimated population, U.S. Census Bureau (www.census.gov [Jan 2010]).

Table 6
2006 Population Estimates by Age and Gender
for an Example Medical Service Area

Age	Population		
	Male	Female	Total
Under 15	780	743	1,523
15-44	1,489	1,473	2,962
45-64	1,022	1,086	2,108
65-74	307	345	652
75+	206	316	522
	3,804	3,963	7,767

Source: 2008 Census estimated population, U.S. Census Bureau (www.census.gov [Jan 2010]).

Table 7
Annual General Surgery Procedures Generated in the Example Medical Service Area

Medical Service Area							
	Male			Female			
Age	Population (000)	Procedure Rate	Procedures	Population (000)	Procedure Rate	Procedures	Total Procedures
Under 15	0.780	14.8	11	0.743	14.2	11	22
15-44	1.489	18.7	28	1.473	42.3	62	90
45-64	1.022	82.4	84	1.086	106.3	115	199
65-74	0.307	180.8	55	0.345	195.0	67	122
75+	0.206	191.6	39	0.316	167.2	53	92
Total	3.804		217	3.963		308	525

[1]Data based on procedures sampled from rural hospitals

Source: The 2006 National Hospital Discharge Survey and 2006 National Survey of Ambulatory Surgery, 2008 Census estimated population, U.S. Census Bureau (www.census.gov [Jan 2010])

Table 8
Two Approaches to Estimating the Number of General Surgeons for an Example Medical Service Area

National Averages Approach	
Procedure Rate/1000 Population[1]	62.0
Average Annual Procedures per General Surgeon[2]	809
Population/General Surgeon Ratio	13,048
Estimated Number of General Surgeons for Example Medical Service Area	.59
Community Specific Approach	
Number of Procedures from Example Medical Service[3]	525
Example Annual Procedures per Local General Surgeon	700
Estimated Number of General Surgeons for Example Medical Service Area	.75

[1] Data based on procedures sampled from rural hospitals, 2006 NDHD and NSAS surveys.

[2] 2007 median annual number of surgery cases per nonmetro single specialty general surgery office, 2008 MGMA Physician Compensation and Production Survey

[3] Data based on procedures sampled from rural hospitals, 2006 NDHD and NSAS surveys, applied to example medical service area.

given the procedures from the list (**Table 4**), an estimated 62 procedures were performed per 1,000 population 2006. The 2008 MGMA Physician Compensation and Production Survey reported an estimated 809 annual procedures were performed per rural general surgeon. This would result in a population-to-general surgeon ratio of 13,048 (809/62), thereby indicating that the example community could support a 0.59 (7,677/13,048) FTE general surgeon.

Table 8 also illustrates that an approach based on specific general surgeon preferences and local population demographics can yield a more accurate estimate. The population of the example service area would generate 525 surgery procedures from the list. Given this estimate, a general surgeon performing 700 procedures annually would require a 0.75 FTE contract. Again, a list of procedures based on a particular general surgeon's scope of practice, number of annual procedures and the need to manage call coverage will impact these numbers.

Summary

The importance of a local general surgeon and the medical contribution that he or she makes to the community can easily be revealed with improvements in residents' health and higher quality of life indicators. However, the economic contribution is not typically quantified. This study clearly demonstrates that economic contributions are equally as important as medical contributions. A rural general surgeon generates approximately $2.6 million in revenue, $1.4 million in payroll (wages, salaries and benefits) and creates 25 local jobs. These effects are underestimated as the impact on the local pharmacy is not included.

The methodologies presented here can serve as tools for community leaders to assess their local health services in terms of general surgery procedures. The results can serve as templates to identify potential health expenditures that might be lost or recaptured by losing or introducing general surgeons to the area. All recaptured dollars can be regarded as new revenue that comes into the community. All revenue changes can either depress or stimulate growth and economic development. They are further amplified by the multiplier effect. Spending patterns and income levels vary across regions and from state to state. Available local data should be utilized to improve accuracy.

Local decision makers should exercise caution when estimating local visits to a general surgeon particularly when utilizing national coefficients that are implemented in this study. As discussed earlier, the number and type of visits to a general surgeon can be significantly different from hospital to hospital depending on scope of practice for the general surgeon and available alternatives. However, in the absence of local data, these national coefficients serve as valuable estimators of potential procedures performed by a general surgeon and anticipated utilization. The process of determining the local value of general surgery to a community as well as the economic risk and potential is likely to expose issues that can and should be addressed in order to promote the community's economic health as well as its clinical needs.

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Appendix A

Model and Data Used to Estimate Employment and Income Multipliers

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Model and Data Used to Estimate Employment and Income Multipliers

A computer spreadsheet that uses state IMPLAN multipliers was developed to enable community development specialists to easily measure the secondary benefits of the health sector on a state, regional or county economy. The complete methodology, which includes an aggregate version, a disaggregate version, and a dynamic version, is presented in Measuring the Economic Importance of the Health Sector on a Local Economy: A Brief Literature Review and Procedures to Measure Local Impacts (Doeksen, et al., 1997). A brief review of input-output analysis and IMPLAN are presented here.

A Review of Input-Output Analysis

Input-output (I/O) (Miernyk, 1965) was designed to analyze the transactions among the industries in an economy. These models are largely based on the work of Wassily Leontief (1936). Detailed I/O analysis captures the indirect and induced interrelated circular behavior of the economy. For example, an increase in the demand for health services requires more equipment, more labor, and more supplies, which, in turn, requires more labor to produce the supplies, etc. By simultaneously accounting for structural interaction between sectors and industries, I/O analysis gives expression to the general economic equilibrium system. The analysis utilizes assumptions based on linear and fixed coefficients and limited substitutions among inputs and outputs. The analysis also assumes that average and marginal I/O coefficients are equal.

Nonetheless, the framework has been widely accepted and used. I/O analysis is useful when carefully executed and interpreted in defining the structure of a region, the interdependencies among industries, and forecasting economic outcomes.

The I/O model coefficients describe the structural interdependence of an economy. From the coefficients, various predictive devices can be computed, which can be useful in analyzing economic changes in a state, a region or a county. Multipliers indicate the relationship between some observed change in the economy and the total change in economic activity created throughout the economy.

MicroIMPLAN

MicroIMPLAN is a computer program developed by the United States Forest Service (Alward, et al., 1989) to construct I/O accounts and models. Typically, the complexity of I/O modeling has hindered practitioners from constructing models specific to a community requesting an analysis. Too often, inappropriate U.S. multipliers have been used to estimate local economic impacts. In contrast, IMPLAN can construct a model for any county, region, state, or zip code area in the United States by using available state, county, and zip code level data. Impact analysis can be performed once a regional I/O model is constructed.

Five different sets of multipliers are estimated by IMPLAN, corresponding to five measures of regional economic activity. These are: total industry output, personal income, total income, value added, and employment. The total impact of a change in the economy consists of direct, indirect, and induced impacts. Direct impacts are the changes in the activities of the impacting industry such as the addition of another physician and corresponding medical staff to the medical service area. The increased purchases of inputs by the new physician practice office as a result of the direct impact are the indirect impact on the business sectors.

Two types of multipliers are generated. Type I multipliers measure the impact in terms of direct and indirect effects. However, the total impact of a change in the economy consists of direct, indirect, and induced changes. Both the direct and indirect impacts change the flow of dollars to the state, region, or county's households. Subsequently, the households alter their consumption accordingly. The effect of the changes in household consumption on businesses in a community is referred to as an induced effect. To measure the total impact, a Type II multiplier is used. The Type II multiplier compares direct, indirect, and induced effects with the direct effects generated by a change in final demand (the sum of direct, indirect, and induced divided by direct). IMPLAN also estimates a modified Type II multiplier, called a Type SAM multiplier that also includes the direct, indirect, and induced effects. The Type SAM multiplier further modifies the induced effect to include spending patterns of households based on a breakdown of households by nine difference income groups.

Minnesota IMPLAN Group, Inc. (MIG)

Dr. Wilbur Maki at the University of Minnesota utilized the input/output model and database work from the U. S. Forest Service's Land Management Planning Unit in Fort Collins to further develop the methodology and to expand the data sources. Scott Lindall and Doug Olson joined the University of Minnesota in 1984 and worked with Maki and the model.

As an outgrowth of their work with the University of Minnesota, Lindall and Olson entered into a technology transfer agreement with the University of Minnesota that allowed them to form MIG. At first, MIG focused on database development and provided data that could be used in the Forest Service version of the software. In 1995,

MIG took on the task of writing a new version of the IMPLAN software from scratch. This new version extended the previous Forest Service version by creating an entirely new modeling system that included creating Social Accounting Matrices (SAMs) – an extension of input-output accounts, and resulting SAM multipliers. Version 2 of the new IMPLAN software became available in May of 1999. For more information about Minnesota IMPLAN Group, Inc., please contact Scott Lindall or Doug Olson by phone at 651-439-4421 or by email at info@implan.com or review their website at www.implan.com.

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