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The general surgery workforce shortage is worse when assessed at county level

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Abstract

\textbf{BACKGROUND:} Multiple studies have documented a significant decrease in the general surgery workforce in the United States, both rural and urban, for the past 3 decades. This 11-year study evaluates the Texas general surgery workforce at both the state and local level in 2002 and 2012.

\textbf{METHODS:} Data were obtained from the Texas Medical Board, the United States Census Bureau/Texas State Library and Archives Commission, and the Texas Department of State Health Services for 2002 and 2012. A benchmark target of 7 general surgeons per 100,000 population was used.

\textbf{RESULTS:} During the study period, the Texas population increased 21\%, and actively practicing physicians increased 44\%. All surgical specialists increased by 26\%. General surgeons increased 4\%; however, the number of general surgeons per 100,000 population decreased 14\% (from 6.7 to 5.8/10\textsuperscript{5}). Using the total Texas population for 2012, an additional 329 general surgeons are needed by benchmark standards. However, when analyzed by individual county population, 449 additional general surgeons are needed in the individual counties. These effects were greater in the nonmetropolitan areas of Texas where per capita general surgeons decreased by 21\%.

\textbf{CONCLUSIONS:} The absolute increase in Texas general surgeons over the past decade has not kept pace with an increase in the Texas population. The general surgery workforce deficit based on the Texas state population underestimates the local workforce shortage, particularly in the nonmetropolitan areas of Texas.

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The general surgeon workforce deficit in the United States had its origin 30 years ago, coinciding with the Graduate Medical Education National Advisory Committee report that predicted a physician surplus of 145,000 by the year 2000.\textsuperscript{1} Congress then created the Council on Graduate Medical Education and in 1992 made specific recommendations to restrain a perceived oversupply of specialist physicians.\textsuperscript{2} Subsequently, the Balanced Budget Act of 1997 (Public Law 105-33) put a cap on the number of residency positions qualified for federal support.\textsuperscript{3}

In 2008, Lynge et al\textsuperscript{4} reported on a 25-year analysis (1981 to 2005) of the general surgery workforce in the United States. They found a 4.2\% decrease in the number of actively practicing general surgeons in both urban and rural areas of the United States during a national population...
growth from 226 to 292 million (an increase of 29%). The decrease was greater in urban areas. The largest decrease in general surgeons to population occurred in nonmetropolitan counties adjacent to metropolitan counties.

In an article examining the workforce change after tort reform, we previously documented a 21% population increase and a 44% increase in the number of actively practicing physicians in Texas in the 11-year period beginning 1 year before (2002) and 9 years (2012) after medical malpractice tort reform in 2003. Although not as much as the total Texas physician workforce, the total number of all surgeons increased after tort reform; however, we did not specifically examine the general surgery workforce. The purpose of the present study was to evaluate the general surgery workforce in Texas at 2 points in time: 2002 and 2012. In addition, changes in this workforce were assessed at the state, county, metropolitan, and rural levels. Because of its large and rapidly growing population and diverse geography and population distribution, Texas may serve as an accurate barometer for general surgeon workforce changes at the national level.

Methods

Data sources

The study was performed using publicly accessible data from the Texas Medical Board (TMB), the United States Census Bureau/Texas State Library and Archives Commission, and the Texas Department of State Health Services. The TMB is the statutorily directed authority that regulates the practice of medicine in Texas. The TMB maintains detailed data with respect to physician demographics, status of practice, location of practice by county, complaints, compliance, litigation, and enforcement. The TMB’s statutory authority is based on 18 chapters of the Occupations Code.

Description of geographic areas

Texas consists of 254 separate counties encompassing 268,581 square miles. In 2002, there were 21,779,893 Texas residents, and in 2012 the estimated Texas population was 26,403,743. Texas counties range in size from a minimum of 127 square miles to a maximum of 6,184 square miles. County populations range from a minimum of 65 people to a maximum of 4.3 million people. County population density in these counties ranges from a minimum of .1 person per square mile to a maximum of 2,851 persons per square mile. Texas consists of 25 distinct metropolitan statistical areas (MSAs). Eighty-eight percent of Texans reside in these 25 MSAs.

Definition of general surgeons, all surgeons, and location

Physicians listing their primary specialty as general surgery were counted as general surgeons. We also counted all surgeons, which included all physicians with their primary specialty as general surgery or any of the other surgical disciplines including all of the following primary specialties: cardiovascular surgery, colon and rectal surgery, abdominal surgery, neurosurgery or neurosurgical subspecialty, gynecologic oncology, orthopedic surgery or any orthopedic subspecialty, otorhinolaryngology, pediatric surgery, plastic surgery or plastic surgery subspecialty, ophthalmology or subspecialty, thoracic surgery, transplant surgery, trauma surgery, surgical critical care, vascular surgery, and urology. Location was defined as the address provided by the licensed physician at the time of initial licensure or renewal.

Data analysis

TMB data tables, with respect to the number of physicians practicing in Texas and the number and specialty of physicians practicing in each county, were retrieved. These datasets were translated into an electronic spreadsheet (Excel 2011 for Macintosh; Microsoft, Redmond, WA).

Surgical specialty and demographic analysis were performed for years 2002 and 2012. This analysis was done using both unadjusted data and data normalized per 100,000 population.

A previously described benchmark of 7 general surgeons per 100,000 population was used as a reference point with respect to adequate surgical manpower. These data were analyzed for the entire state and by individual county. Using this benchmark, the optimum general surgical workforce was calculated by the following formula: (7/100,000) × county population, which equals .00007 × county population. Using this formula, counties with less than 7,145 residents would be calculated to support less than .5 surgeons, so these counties were classified as having too few patients to support a general surgeon. This is an arbitrary but clear cutoff point. The number of surgeons was determined using this formula, which was rounded to the nearest whole number. As an example, a county with 18,000 residents equates to (7/100,000) × 18,000, which equals 1.26; therefore, this county could support 1 general surgeon. The estimated need for general surgeons in a county was calculated by subtracting the actual number of general surgeons in the county from the calculated benchmark number of general surgeons. If a county had no surgeons but benchmark calculations showed a need of 2.4 surgeons, the county would be deemed to have a deficit of 2 surgeons. These calculations were performed for each county and for the state as a whole. The estimated need for the state was calculated by 2 different methods. The first used the formula described previously using the overall state population. The second method was to calculate the deficit or surplus in each individual county and then sum the calculated deficit in the individual counties.

Nonparametric data were analyzed using a chi-square test with the Yates correction for nominal variables. Statistical analyses were performed using SAS version 9.2.
9.3 for Windows (SAS Institute, Cary, NC); StatPlus (AnalystSoft Inc, Alexandria, VA), a statistical analysis program for MAC OS; Excel; and GraphPad Prism (GraphPad Software Inc, San Diego, CA) for Mac. Differences were considered statistically significant if the *P* value was < .05. Population change data were assessed with a repeated measures Poisson model.

**Results**

**Texas general surgical workforce in 2002**

In 2002, there were 21,779,893 Texans residing in 254 discreet counties. There were 35,617 licensed physicians in the state of Texas. Of the 35,617 physicians, 5,934 listed their specialty in 1 of the surgical disciplines (17%). Of the 5,934 surgeons, 1,461 listed their primary specialty as general surgery (25%). Using the benchmark of 7 general surgeons per 100,000 population, the need for general surgeons in the state as a whole was 1,525 surgeons (Fig. 1). Compared with this benchmark, the state had a deficit of 64 general surgeons. At the county level, there were 121 counties with no general surgeon. Based on the population benchmark (7/100,000), 63 of these counties were too sparsely populated to support a surgeon. Fifty-eight of these counties without surgeons could support at least 1 surgeon. Forty-six counties could support 1 surgeon, 8 could support 2, 2 could support 3, and 1 could support 8. There were another 53 counties with at least 1 general surgeon in the county that could support an additional 259 general surgeons. Thus, there were 63 counties too sparsely populated to support a surgeon, and 111 counties with a deficit of 335 general surgeons. There were 44 counties with a surplus of 276 general surgeons.

Counties not in MSAs were analyzed separately. Fifty-seven of these counties had no surgeon but had a population that could support at least 1 general surgeon. There were 41 nonmetropolitan counties without a surgeon, which could support a total of 45 surgeons (38 could support 1 surgeon, 2 could support 2 surgeons, and 1 could support 3 surgeons). There were another 20 nonmetropolitan counties with at least 1 general surgeon in the county that had a calculated deficit of 32 surgeons. By the benchmark standard, 61 nonmetropolitan counties had a deficit of 77 surgeons (Table 1).

**Texas general surgical workforce in 2012**

In 2012, there were 26,402,224 Texans residing in 254 discreet counties. There were 51,217 licensed physicians in the state of Texas. Of the 51,217 physicians, 7,491 listed their specialty in a surgical discipline (15%). Of the 7,491 surgeons, 1,519 listed their specialty as general surgery (25%). Using the benchmark of 7 general surgeons per 100,000 population, the need for general surgeons in the state was 1,848 surgeons (Fig. 2). Compared with this benchmark, the state had a deficit of 329 general surgeons. At the county level, there were 127 counties with no general surgeons. Based on the population benchmark (7/100,000), 66 of these counties were too sparsely populated to support a surgeon. Sixty-one of these counties could support at least 1 surgeon: 46 could support 1, 9 could support 2, 4 could support 3, 1 could support 4, and 1 could support 5. There were another 65 counties with at least 1 general surgeon in the county that could support an additional 369 general surgeons. Thus, there were 66 counties too sparsely populated to support a surgeon, and 126 counties with a deficit of 449 general surgeons. There were 31 counties with a surplus of 135 general surgeons.

Of the 254 counties, 178 are not included in any MSA. These nonmetropolitan counties were analyzed separately. Forty-eight of these counties had no surgeon but had a population that would support at least 1 general surgeon. These 48 counties had a population base that would support a total of 60 surgeons (41 counties could support 1 surgeon, 5 counties could support 2 surgeons, 1 county could support 4 surgeons, and 1 county could support 5 surgeons). There were another 27 nonmetropolitan counties with at least 1 general surgeon in the county that had a calculated need for additional surgeons. These 27 counties accounted for a further deficit of 38 surgeons. Thus, 75 nonmetropolitan counties that had a population adequate to support a surgeon had a deficit of 98 surgeons (Table 1).

**2002 to 2012 comparison**

From 2002 to 2012, the Texas population increased by 21%. The number of Texas physicians increased by 15,611 (44% increase). This absolute change accounted for an increase of 30 physicians per 100,000 population (19% increase, *P* < .01). All surgeons (general surgery and all of the surgical specialties) increased by 1,557 (26% absolute increase and an increase of 1.1 surgeons/100,000, *P* = .02). General surgeons increased by an absolute number of 58 physicians for an absolute increase of 4%. The number of general surgeons per 100,000 population decreased from 6.7 general surgeons per 100,000 population to 5.75 general surgeons per 100,000, a 14% decrease in general surgeons per capita (*P* < .01). Using the benchmark of 7 general surgeons per 100,000, the aggregate deficit of general surgeons in the state increased from a deficit of 64 in 2002 to a deficit of 329 in 2012. Including counties with a calculated deficit and an adequate population base to support a general surgeon, the deficit was more severe (ie, 335 in 2002 vs 449 in 2012).

From 2002 to 2012, Texas metropolitan areas increased in size disproportionately to nonmetropolitan areas (23% vs 8% increase in population, respectively). Texas general surgeons in these nonmetropolitan areas decreased from 170 in 2002 to 143 in 2012. These changes resulted in a per capita decrease of nonmetropolitan general surgeons from 5.7 per 100,000 population to 4.5 per 100,000 in 2012, a 21% decline. All surgical specialists in these nonmetropolitan
areas increased from 391 in 2002 to 406 in 2012. This absolute increase did not keep up with the modest population growth, resulting in a decrease from 13 per 100,000 in 2002 to 12 per 100,000 in 2012, a 5% decline of the total surgical workforce.

Comments

Key findings

From 2002 to 2012, the number of Texas general surgeons did not keep pace with the increase in the Texas population. This relative general surgical workforce decrease countered the increase in all surgical specialists and primary care physicians over the same time period. This decrease was particularly acute in the nonmetropolitan areas of Texas, where general surgeons decreased to 4.5 per 100,000 population, a 21% decrease over the study period (33% less than benchmark). Compared with the benchmark, Texas had a deficit of 329 general surgeons compared with the relatively modest deficit of 64 surgeons in 2002. The deficit appears worse when viewed from the level of the local county, particularly the nonmetropolitan counties. Using the benchmark from individual county analyses, 126 individual counties had a total deficit of 449 surgeons. Lastly, it is clear that the US Mexico border areas of Texas and the east-central, nonmetropolitan regions have significant general surgical workforce problems.

Comparison with previous data

For the past decade, there has been growing consensus among physicians, medical school deans, hospital administrators, and economists that “a serious physician shortage in both primary care physicians and specialists is looming on the horizon.”10–12 In 2005, the Council on Graduate Medical Education revised its stated policy on a physician shortage and predicted a national deficit of 85,000 to 96,000 physicians by 2020.10 In a survey of 5,000 hospital administrators in 2007, the Penn Consortium of Health Workforce Research and Policy showed that 86% of hospital administrators reported a deficit in the needed number of physicians at their institutions and that recruiting was both difficult and challenging.13 In contrast, a lone report by

Figure 1 2002 Map of Texas depicting surgeon workforce relative to benchmark of 7 general surgeons/100,000 population.
Goodman\textsuperscript{14} in 2007 refuted the widely held hypothesis of a national physician shortage. He reported an increase in the national physician to population ratio from 207/105 in 1980 to 296/105 in 2000.

In 2002, Richardson\textsuperscript{15} predicted a general surgery workforce shortage in his presidential address to the Western Surgical Association. He cited the many problems associated with recruiting and retaining general surgeons and multiple factors contributing to the general surgery workforce shortage including subspecialization, maldistribution, and early retirement.

To call attention to the national shortage of general surgeons, Fischer\textsuperscript{16} boldly titled his commentary “The Impending Disappearance of the General Surgeon.” He cited flawed reimbursement and escalating medical malpractice lawsuits and premiums as 2 additional factors adversely affecting the number of actively practicing general surgeons. The American Medical Association report in 2007 showed a decrease in the percentage of general surgeons in the total physician workforce from 8% in 1975 to 4.5% in 2005.\textsuperscript{17} In 2009, Williams et al\textsuperscript{18} addressed the impending shortage of 7 surgical specialties including general surgery. To

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<tr>
<th>Table 1</th>
<th>Changes in physician workforce in Texas</th>
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<tr>
<td></td>
<td>2002 population</td>
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<tr>
<td>Texas</td>
<td>21,779,893</td>
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<td>Surgery (all disciplines)</td>
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<td>General surgery</td>
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<tr>
<td>Nonmetropolitan general surgery</td>
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Figure 2  2012 Map of Texas depicting surgeon workforce relative to benchmark of 7 general surgeons/100,000 population.
calculate the future surgical workforce demand, they used the following 4 models: work per capita analysis, population analysis, Cooper trend analysis, and the Physicians Supply Model. Using these models, they estimated a shortage of 1,300 general surgeons in 2010 and a deficit reaching 6,000 general surgeons by 2050.

A 25-year longitudinal analysis of the general surgery workforce in the United States was provided by Lynge et al. The general surgeon to population ratio declined 26% from 7.68/105 in 1981 to 5.69/105 in 2005. The overall urban ratio dropped 27% (8.04 to 5.85/105). Of note, the average age of rural general surgeons increased compared with urban surgeons. Women were disproportionately concentrated in urban areas. Multiple authors have published the following similar reductions in the general surgery workforce: 6.93/105 in 1974, 7.1/105 in 1994, 6.0/105 in 2007, and 5.0/105 in 2009.

In 2007, Goodman reported a 15% decrease in the number of US general surgeons per 100,000 populations over a 20-year period. Compared with all other physicians, general surgeons were moving from lower physician density areas to the higher physician density areas (ie, they were leaving rural areas). Thompson et al reported on the density of general surgeons, which ranged from 6.53/105 in urban areas to 7.71/105 in large rural areas and a low of 4.67/105 in small, isolated rural areas. These rural surgeons were older and approaching retirement. North Carolina has experienced its own rural general surgery shortage. In 2005, 22 counties had no general surgeon, and 53 other counties experienced a decline in the number of actively practicing general surgeons. Substantial reductions in the rural general surgery workforce in Missouri have also occurred. According to Lynge et al, 18% of general surgeons were practicing in rural areas during their study period (1981 to 2005). Compared with urban areas, the rural general surgery workforce had a decrease in the number of general surgeons younger than 40 years of age and an increase in the number of those 50 to 62 years of age. According to Polk et al, 2 smaller Kentucky cities epitomize the rural shortage of general surgeons. One city with a population of 12,320 in 2007 experienced a decrease in the number of general surgeons from 8 in 1975 to 3 in 2009. The other city with a population of 19,076 in 2007 had 6 general surgeons, and within 2 years it had one half that number.

**Limitations**

There are a number of limitations of this present study. Specialty classification was self-reported, and, with the proliferation of specialists related to general surgery, there is a possibility that a significant portion of the change could simply be caused by a self-reported specialty classification change rather than an actual change in practice. This is more probable in urban areas and less likely in nonurban areas, where there are very few general surgical subspecialists. The difference between overall deficit and individual county deficit reflects regionalization of care with a shift to metropolitan counties. Our data did not look at patient outcome.

**Conclusions**

The increase in the number of Texas general surgeons did not keep pace with the increase in Texas population. These data are consistent with previous reports from other areas. The decrease of general surgeons contrasts with an overall per capita increase of other surgical specialists and primary care physicians in Texas and is worse when viewed from the county level. Our data, which are consistent with previous reports, raise concern over the future of the general surgical workforce, particularly in nonmetropolitan regions.

**References**

8. Texas Department of State Health Services. Population Data for Texas. Austin, TX: Texas Department of State Health Services; 2012.

Discussion

Joel Harris, M.D. (Summit, WI): Thank you very much for an excellent article, and I want to express gratitude to the Congress for the opportunity to discuss it. The topic of physician shortage, particularly in general surgery, has been discussed in different forms at this meeting because of the severity of the shortage. We could debate at length about the use of 7 general surgeons per 100,000 as sufficient to care for population, but regardless that is used in the literature, and I think it is a reasonable assumption. Where your group is specifically adding to the literature is in comparing general surgeon trends in Texas using identical methodology in 2002 and then again in 2012. It is important to see the absolute number of surgeons calculated in the shortage, but these trends are staggering if you look at the change in just 10 years. I do have a few questions. Looking at data by county raises some significant questions. The counties in Texas are as small as 127 square miles and as large as 6,200 square miles. Population density is not uniform, and many people will travel quite a distance to receive their health care given geography and centralization of care. Did you give consideration to using rural urban commuting area codes or other descriptors to better characterize not just where the surgeons are living and practicing, but what the commuter flow is like around those areas? You were able to show an overall increased number of physicians during the 10 years and attributed some of that to the tort reform. However, general surgeons did not increase nearly as much. Therefore, do you believe there may potentially be provisions in the tort reform that are less favorable to general surgical practice than other disciplines? In Texas, there was a rural growth of approximately 9% in your study. This finding made the disparity of general surgeons proportionately greater as they are moving in the opposite direction, toward urban areas. Rural populations in many states are declining. Therefore, does this finding potentially limit the ability to generalize your results to other areas of the country? The general surgeon shortage crisis is no longer coming, it is here. There is not time, funding, or political will to train enough surgeons to fill this void. How do you see the role of advanced practice providers filling this void? Thank you.

Ronald M. Stewart, M.D. (San Antonio, TX): Thank you very much Dr Harris. With respect to the rural urban commuting codes, that is an excellent idea and probably it is something that we could have done, but we did not use rural urban commuting data. As you know, we broke it down by metropolitan statistical area, which I think gets to the same general principle. You are correct with respect to the large urban centers (ie, Dallas, Houston, Austin, San Antonio, El Paso, Lubbock, and Temple), so I do think there are rings of counties that look underserved at a county level but may not be underserved because of a regionalization model. I think the graphic display on the map shows regionalization pretty clearly. With respect to tort reform in Texas and surgeons, was tort reform less favorable to surgeons, the answer is no. It is probably quite favorable to surgical practice. The decrease in general surgeons relative to population probably has to do with the number of general surgeons being trained in Texas, which is probably too low relative to the increase in population. The other factor that you allude to, which is valid and makes the data harder to interpret, is specialization. Although not in the data presented, we did examine subspecialization of general surgery. Taking subspecialization into account, I think there is a likely a shortage of general surgeons, particularly with respect to rural areas or nonmetropolitan areas. Regarding your last question with respect to advanced practice clinicians, clearly there is a role for advanced practice clinicians. We have had a great session at this meeting, discussing the important role of advanced practice clinicians in surgical practice. They play an important role, and I think will play a greater role in the future in Texas and throughout the Southwest.

Wayne Anderson, M.D. (Williston, ND): Ron, nice presentation. I echo what you say. Your numbers are scary; mine are even scarier. Looking at your population density, you have about 98 people per square mile. I have a population density of 1.6 people per square mile. Our area encompasses roughly 51,000 square miles. In that area, we have about 80,000 people. We have, by my count, easily 11 to 12 counties that do not have a surgeon, and some of them do not even have a hospital. They might be served with an advanced practice nurse. But the numbers are pretty scary. In our area, I would say we have about 8 surgeons, at least 4 but maybe 5, who are in their late 50s or early 60s. Many of them are ready to retire. For example, Sidney and Glasgow, MT, each have only 1 surgeon. We are all 60 years of age. It is going to be very difficult to recruit for these smaller communities. I bristle a little at the term acute care surgery because I do that on a daily basis along with an elective practice. So, I thank you for bringing this to our attention. I think there are some areas of the country where it is even more critical than other areas. Thank you.
Dr Stewart: Thank you very much for your comments. I really appreciate them. I appreciate everything you do with respect to your state and region. For those rural surgeons in the audience, it is an honor to interact with you at this meeting. I do think you are right. It is a crisis in rural Texas and throughout the rural Southwest, and if you consider aging surgeons with the aging population, it compounds the problem. As we showed in our data, there are definitely large tracks of Texas that have counties with too small of a population to support a general surgeon, but there are many that have a population adequate to support a general surgeon that simply do not have them (more in 2012 than 2002). It is a significant problem, and I do not think it is going to be solved by specialization and regionalization. As I said in the rural surgery session at this meeting, I think there are going to have to be financial incentives to completely address the problem. Otherwise, I agree with you; this is not a bright recruiting situation for many rural communities. The other potential help in Texas would be international medical graduates who are trained in the United States, trained surgeons in the United States; the rules with respect to immigration, at least in our state, essentially do not provide enough room for them to enter practice in the state. Thank you very much.

Barbara Pockaj, M.D. (Phoenix, AZ): I think this is a little bit of the elephant in the room. The problem is that there are not a lot of people going to these small areas; it is a very difficult place for people to live. A lot of our young residents are couples who both have careers that are important; there may be a general surgeon who can work there, but his/her spouse may not be able to find a job that will actually fulfill him/her in those areas. So, I think part of the social isolation and some of the opportunities in these small areas make it very difficult to recruit someone. I think unless that is addressed by some sort of benefit for someone to go to those areas, it is going to continue to be hard. Therefore, I do not think it is only an issue of superspecialization or these other things. I think there are other issues that are also important there that you have to address.

Dr Stewart: I agree with your statement of the problem. As I said in the rural surgery session at this meeting, I think there are going to have to be financial incentives to completely address the problem. Otherwise, I agree with you; this is not a bright recruiting situation for many rural communities. The other potential help in Texas would be international medical graduates who are trained in the United States, trained surgeons in the United States; the rules with respect to immigration, at least in our state, essentially do not provide enough room for them to enter practice in the state. Thank you very much.