J Gastrointest Surg (2014) 18:1032–1039
DOI 10.1007/s11605-013-2416-x

ORIGINAL ARTICLE

Will There Be A Good General Surgeon When You Need One?

Ross F. Goldberg · Kaye M. Reid-Lombardo · David Hoyt · Carlos Pellegrini · David W. Rattner · Tara Kent · Daniel Jones · Public Policy & Advocacy Committee of the SSAT

Received: 18 October 2013 / Accepted: 4 November 2013 / Published online: 19 December 2013

Abstract
Introduction The Public Policy & Advocacy Committee sponsored the panel on the topic of "Will There Be a General Surgeon When You Need One?" at the 2012 Annual Meeting of the SSAT.
Summary The panel of experts was convened to formulate recommendations to help general surgeons adapt to the changing landscape which will undoubtedly affect the practice of surgery in the future. The invited speakers were Drs. David Hoyt, Carlos Pellegrini, Kaye M. Reid-Lombardo, and David Rattner. The session was moderated by Drs. Ross Goldberg and Tara Kent. The invited presentations and audience commentary are the basis of this manuscript.

Keywords Surgeon shortage · Health care policy · Affordable health care act · Advocacy

Presented at the 53rd Annual Meeting of the Society for Surgery of the Alimentary Tract on May 21, 2012, Chicago, IL

R. F. Goldberg
Department of Surgery, Maricopa Medical Center, Phoenix, AZ, USA

K. M. Reid-Lombardo (✉)
Department of Surgery, Mayo Clinic, 200 First Street SW, Rochester, MN 55905, USA
e-mail: Reidlombardo.kaye@mayo.edu

D. Hoyt
American College of Surgeons, Chicago, IL, USA

C. Pellegrini
Department of Surgery, University of Washington Medical Center, Seattle, WA, USA

D. W. Rattner
Division of Gastrointestinal and General Surgery, Massachusetts General Hospital, Boston, MA, USA

T. Kent · D. Jones
Department of Surgery, Beth Israel Deaconess Medical Center, Boston, MA, USA

Public Policy & Advocacy Committee of the SSAT
Society for Surgery of the Alimentary Tract, Beverly, MA, USA

Workforce Shortage for Gastrointestinal Surgeons

Kaye M. Reid-Lombardo, M.D., M.S. Mayo Clinic, Rochester, MN

Who is a General Surgeon?

In order to resolve if there will be a general surgeon shortage, we first have to define and agree upon the type of practicing surgeon that falls under the heading of "general surgeon" and determine what the ideal minimum acceptable ratio of surgeon to 100,000 persons in the population. Many surgeons would accept, without argument, that a general surgeon is board certified in general surgery or a subspecialist who performs a large percentage of general surgery in their practice. In his update from the American Board of Surgery (ABS) to the Center for Rural Surgery, Dr. Steve Stain provides a sensible definition of the general surgeon as someone with *comprehensive training* in the alimentary tract, abdomen, breast, skin and soft tissue, endocrine system, and acute-care surgery; but they should have *knowledge* of critical care, surgical oncology, trauma and burns, and be *familiar* with transplantation, pediatric surgery, thoracic surgery, and vascular surgery.[1]

Increasingly, however, the "general" surgeons' experience is morphing into that of a gastrointestinal surgeon, as the

focus of the operative practice is generally restricted to the abdominal cavity. Proof of this change is supported by a recent report evaluating the operative procedures performed by general surgeons as reported by the ABS. Sheldon et al. reported that the most common procedures performed by the average general surgeon in 2004 were all within the area of gastrointestinal surgery (cholecystectomy, intraoperative cholangiogram, hemorrhoid procedures, colonoscopy colorectal resection, and upper gastric intestinal endoscopy; Fig 1).[2] Coupled with this observation is the decline of the number of board-certified general surgeons annually. The ABS reported a decrease in the number of board-certified general surgeons from a historic high of 1,200 annually to 909 in 2009, a 24 % reduction.[2]

The expected role of a general surgeon as the broad based practitioner has also undergone a shift in expectations over the last decade due to the demand and increased subspecialization in areas of general surgery: minimally invasive surgery, bariatric, colorectal, and hepato-pancreato-biliary surgery, which has led to an increase in the number of these fellowship opportunities over the last decade.[3]

What is the Minimum Acceptable Surgeon-to-Population Ratio?

In addition to a decrease in the number of board-certified general surgeons, there is a concurrent increase and aging of the population of the United States (US). The population is expected to grow to 400 million by 2050.[4] In 1980, the minimum surgeon-to-population ratio recommended by the Graduate Medical Education National Advisory Committee (GMENAC) was 4.7–4.9/100,000.[5] By 2004, it was reported that the minimum surgeon-to-population recommendation was higher, 6/100,000.[6] Even with these minimum recommendations in place, 958 out of 3,107 (31 %) counties in the US do not have any general surgeon.[7] The states that fall below the minimum recommendations are Nevada, Oklahoma, and Arkansas (Fig. 2). The states that greatly exceeds the recommendations with >25 general surgeons/100,000 population are Oregon, Montana, Maine, Vermont, New Hampshire, Massachusetts, New York, Connecticut, Delaware, Tennessee, Louisiana, Florida, and Hawaii.[7] There is a clear misdistribution of resources with most of the resources congregating in the north east and eastern coast of the US.

CCS Procedure Category	Number Performed in 2004
Cholecystectomy and common duct exploration	107
Intraoperative cholangiogram	82
Inguinal and femoral hernia repair	42
Appendectomy	31
Other hernia repair	29
Hemorrhoid procedures	25
Other OR lower GI therapeutic procedures	25
Colonoscopy and biopsy	22
Colorectal resection	22
Upper gastrointestinal endoscopy; biopsy	21
Excision of skin lesion	17
Other non-OR therapeutic procedures on skin and breast	16
Total	471
Subtotal: top 10 procedures	406
Outcome measures	
Total procedure volume	471
Number of different types of procedures	14
Share of procedures concentrated in top 10 procedures	86%

Fig. 1 Outcome measures calculation example; procedures performed by individual general surgeon. Adapted from: King J, Fraher EP, Ricketts TC, Charles A, Sheldon GF, and Meyer AA. Characteristics of Practice Among Rural and Urban General Surgeons in North Carolina. Ann Surg 2009; 249:1052–1060. Reprinted with permission from Lippincott Williams & Wilkins October 13, 2013

Population Growth Impacts Shortage

The decrease in general surgeons and misdistribution will need to be addressed as current population projections show a steady increase in the population to the year 2050. The expectation is that the population in the US will be close to 400 million persons and will have a large percentage of patients over the age of 65 with 70 million people falling into that category. In 2000, Williams et al. calculated the amount of general surgery shortage per decade and estimated that by 2050 there will be a 20 % shortage below the estimated number of necessary general surgeons compared to those actually in practice.[8] The shortage nearly doubles over the period of 2040 and 2050. As early as 1992, the impending shortage was recognized by the Council on Graduate Medical Education (COGME) in their Third report that stated "the future growth of general surgery services is likely to exceed the growth in the supply of general surgeons. Aging of the US population will increase demand for surgical services, and the number of physicians in general surgery is inadequate to meet a growing need for trauma care services and for surgical care in rural areas."[9] The fact is that 70 % to 80 % of trainees are going into fellowship training and so that leaves a small percentage of trainees going into general surgery and general surgery in a nonacademic setting.[10] Only 68 % of surgeons that recertified during 2007–2009 certified in general surgery alone (i.e., without a fellowship) and an increasing amount of graduates go into non-ABS fellowships (e.g., minimally invasive and hepato-pancreato-biliary surgery; Fig. 3).

In addition, according to the ABS survey, men perform an increased number of cases per year when compared to females (506 versus 375).[11,12] Females comprise an increasing percentage of the workforce but perform, on average, more breast and less alimentary tract procedures.[11,12] This may cause a significant impact in the future as we realize the alimentary tract comprises most of a general surgeon's workload. Some women surgeons take time away from their career for childbearing, thus affecting the availability of their skillset

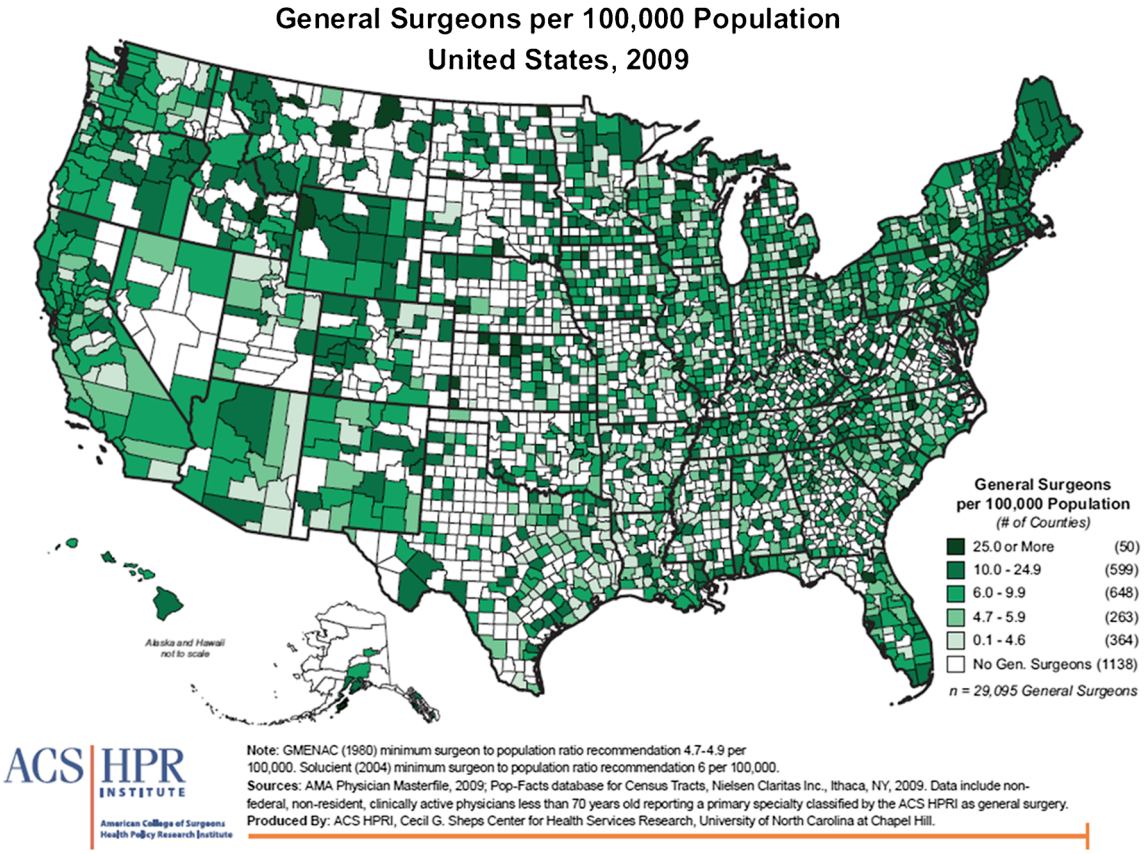

Fig. 2 General surgeons per 100,000 population, USA, 2009. Gaul K, Poley ST, Ricketts III TC, Walker E, and Groves J. Mapping the Supply of Surgeons in the United States, 2009. Chapel Hill, North Carolina, American College of Surgeons Health Policy Research Institute, April 2010. Reprinted with permission from American College of Surgeons Health Policy Research Institute October 17, 2013

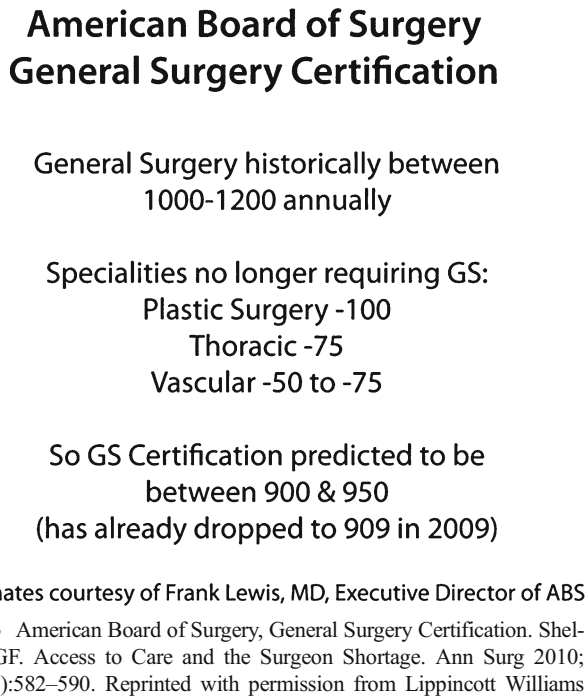

Fig. 3 American Board of Surgery, General Surgery Certification. Sheldon GF. Access to Care and the Surgeon Shortage. Ann Surg 2010; 252(4):582–590. Reprinted with permission from Lippincott Williams & Wilkins October 17, 2013

to the workforce. The impact of the changing landscape of surgery with increasing women in the pipeline will need to be considered with any policy changes that are recommend.

Possible Solutions

Strategies to address these issues include earlier exposure of students in the pipeline to surgery, possibly as early as high school but more likely college. The employment of this approach would require collaboration from colleges, national surgical societies and surgical departments to be successful. Other solutions require fiscal backing and policy changes. The COGME did state that there should be an effort made to improve the problems of access to this shortage in supply and that strategies should include altering the specialty mix, the racial ethnic composition, and geographic distribution of positions.[13] In their 18th report, the COGME made recommendations to encourage graduates to serve in underserved areas by developing federal loan programs for surgeons to creating incentives for service in underserved areas. They also recommended creating a national medical school such that graduates would be targeted and directed to areas of shortage

(rural and inner city).[14] Federal loan programs in exchange for working in surgeon shortage areas may help with redistribution of surgical expertise and may help current graduates manage the rising and significant debt of medical school (Fig. 4).

The supply of medical students is actually on the verge of increasing with a 19.4 % improvement from baseline.[15] The projected number of applicants is also on the rise, so there is a larger population from which to draw. The supply of general surgery residency slots, however, creates the bottleneck. The slots for residency training have been fixed since 1966, and the number of board certified general surgeons has decreased to approximately 900 a year.[16] A survey from 2011 suggested that 80 % of programs could support an expansion of 1.9 residents per year for a net increase of 249 residents after 5 years[16]; however, an increase to Graduate Medical Education (GME) funding is unlikely given the current economic climate. With the past expansion of fellowships and GME restrictions on residents interacting with fellowships, it is not realistic to expect a future expansion of general surgery residency slots without extensive lobbying. Long-term policy and permanent changes would require policy changes such as: protection and increase of general surgery slots by the GME; development of financial incentives for working in the rural areas, for example with loan forgiveness programs; a lobby effort to support increased funding for the GME and focus funding from GME to training programs in high need areas.

Short term solutions include: (a) employment of foreign trained surgeons as many centers have done; however, over time, the percentage of foreign trained individuals employed by US hospitals has declined; (b) increasing medical school slots which are ongoing to 17,000 per year; and (c) target osteopathic graduates which have increased over time to a current 4,000 graduates per year.[17]

Perceptions of Surgeon Workforce

To better understand the perception of medical students, residents, and surgeons in practice, the SSAT has recently completed a national survey (manuscript in preparation). The study's findings suggest a potential gap in the supply of general surgeons. Surgeons in practice believe that loan forgiveness will attract trainees to General Surgery, while trainees expressed lifestyle as a major obstacle to recruiting to Surgery.

National Context of Health Care Policy

David B. Hoyt, M.D., Executive Director, American College of Surgeons, Chicago, IL

While policies may contribute to a future of surgeon shortage, health care reform and policy are changing the landscape in which the general surgeon has to currently practice. It is now more vital than ever that the general surgeon not only be aware of these ever-changing policies but be an active participant in how they are shaped in order to provide high-quality care to their patients. To understand what practice environment the general surgeon of the future will have to face, one has to understand the policies and reforms that are shaping it.

The forces affecting health care reform and health care policy can be divided into three important focus areas: (a) quality and professionalism, (b) cost and payment, and (c) workforce and training. All of these areas impact the practice

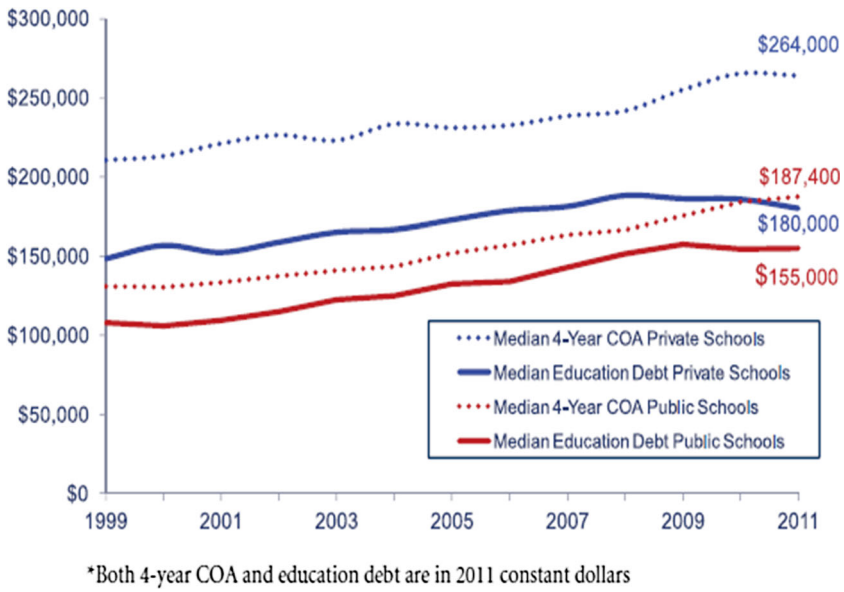

Fig. 4 Median 4-year cost of attendance (COA) and education debt of indebted Medical School Graduates U.S. Medical Schools. 1999–2011. Youngclaus J. Analysis in Brief 2012, 12(2):1–2. Reprint permission request submitted to Association of American Medical Colleges October 17, 2013

of the future general surgeon and the training of general surgeons.

Recently, the government, healthcare institutions, and the public have become increasingly focused on efforts to improve the quality and value of health care that is delivered. The goal of quality improvement is a shared interest between all involved parties and a shared mission; and all involved parties must be actively involved in devising solutions. Recent policy changes nationally and locally have created a rapidly changing health care environment affecting providers and patients. To address quality, the National Strategy for Quality Improvement in Health Care was established by Health and Human Services to improve health and raise the bar to higher quality health care, while shifting health care to a patient-centered delivery process that is accessible and safe. The Strategy for Quality Improvement in Health Care is also promoting healthy lifestyles and earlier appropriate interventions for preventive care and health maintenance in order to manage disease risk and cost.

Another important and developing goal is to recommend changes in health care management to allow for rapid modifications to practice based on patient outcomes captured from databases and the electronic medical record (EMR). Don Berwick, former Administrator of the Centers for Medicare and Medicaid Services, has stated that the health care system improvement requires an improved experience of care, improved population health, and decreased per capita health care costs.[18]

An important key to health care reform is setting the foundation for the ability to exchange electronic health information. The success of the EMR can improve the quality and efficiency of health care, empower the individual patient, support public health, support emergency readiness and preparedness, and help support continuing research to improve upon health care quality. To accomplish this task, a minimum set of detailed standards needs to be established, while supporting consumer/inter-organizational trust and ensuring that the value of exchanging data exceeds the cost of collecting it. The required use of EMR by all providers is the first step.

The American College of Surgeons (ACS) has responded to the need for outcomes-based and higher quality of care by developing National Surgical Quality Improvement Program (NSQIP). The NSQIP allows for rigorous data monitoring and allows for evaluation of current practice to improve on an outcome of interest. Surgeon participation is important to the success of programs like NSQIP given the need for the surgeon of the future to lead safe high-performance teams, integrating surgical and nonsurgical skills, while relying on evidence-based medicine and using outcomes data to self-report and help drive continuous professional development (Fig. 5).

The second important factor impacting health care reform is cost. Although health care costs have rapidly increased over the last decades, the spending curve from the area of surgery has remained relatively flat on that spending curve (Fig. 6). Even still, there is room for improvement. In reviewing the impact that NSQIP has had on surgical quality to this point, 82 % of participating hospitals decreased their complications, 66 % of hospitals decreased mortality and 250–500 complications were prevented annually per hospital.[19] Study of the cost savings associated with these efforts yield the following information: the average cost per complication is approximately $11,000, one complication reduction per day is a savings of approximately $2.9–5.8 million over the year, $13–26 billion savings annually (based on 4,500 private US hospitals).[19] Programs like this help hospitals and physicians

Fig. 5 Four guiding principles of continuous quality improvement. American College of Surgeons: 100-Year History of Leading Quality Improvement. Reprint permission request submitted to the American College of Surgeons October 17, 2013

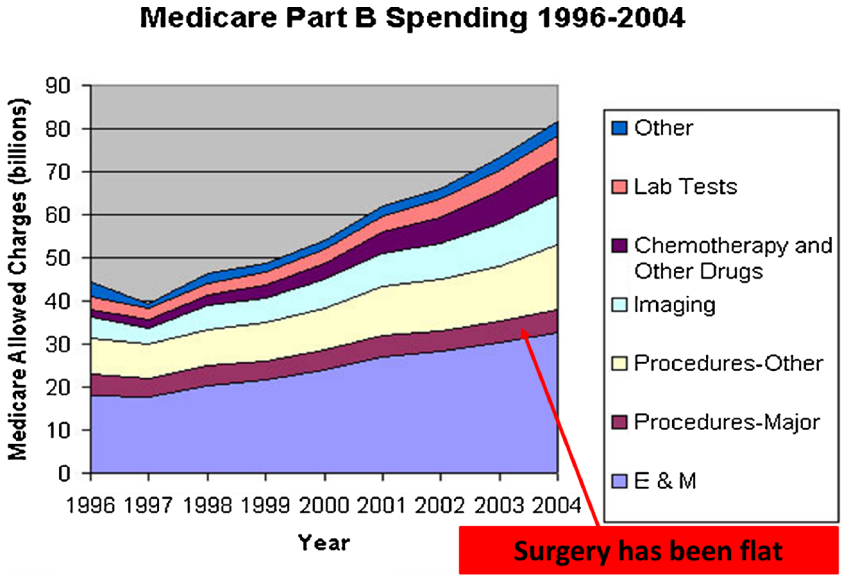

Fig. 6 Medicare allowed charged by type of service, 1996–2004. Nonnemaker L and DHHS/OS/ASPE. Short-Term Fixes to the Sustainable Growth Rate Process. Reprint permission request submitted to ASPE/DHHS October 17, 2013

improve care by reducing preventable complications, which leads to a change of hospital culture into one that focuses more on an evidence-based learning environment.

Finally, there is the issue of workforce and training. Over the last 9 years, the concept of surgical residency training has been altered with the introduction of two concurrent changes to duty hour regulations which reduced the maximum number of hours per week allotted to training. This policy change has reduced the amount of exposure that trainees have to their field likely prompting the increased number of desired fellowships. Added to this concern are the reports that the surgical workforce is decreasing (16 % reduction in full-time equivalent surgeons by 2028),[20] leaving fewer available surgeons for an aging population. Furthermore, the distribution of surgeons within the US is uneven. In 2009, for example, 959 counties in the US were without a surgeon, and 95.4 % of these counties were rural communities.[21] Nineteen percent of Americans live in these rural communities without surgeon access; even still, there are major cities with a glut of surgeons. Prior to making recommendations to solve this issue, it is important to understand who the current providers of general surgery are and what the minimum required for the delivery of quality healthcare will be.

How Will Healthcare Reform Change My Surgical Practice?… Or How Has Reform Already Changed My Practice?

Carlos Pellegrini, M.D., Department of Surgery, University of Washington Medical Center, Seattle, WA

Healthcare reform, or specifically, healthcare insurance reform, has refocused the priorities of the general surgeon's practice. As previously discussed, there has been an increased emphasis on quality of care, increased innovation, on more transparency, on changes in systems of practice, on improved costs and improved efficiency and increased access to care. The creation of NSQIP is one example of how the world of surgery has attempted to focus on and improve upon surgical quality. The emphasis on innovation has come with focus on improving and expanding upon the electronic medical record system, while simultaneously using technology to more accurately collect detailed outcomes to better improve upon quality. This helps to build upon the comparative effectiveness concept and help promote changes within systems of practice. Funding for such innovations has to be dispersed among a variety of sources; this includes the 10-B Medicare Innovation Fund, the American Recovery and Reinvestment Act (ARRA; funds that were made available for research), funds from the Agency for Healthcare Research and Quality (AHRQ), and funds from Congressional directives.

An example of how this has and can work is the Washington State Surgical Care and Outcomes Assessment Program (SCOAP).[22] This surgeon-led collaborative uses data-driven quality surveillance and response systems to deliver a more appropriate, safer, and higher quality surgical care across the Pacific Northwest with the commitment of participation by all surgeons in all hospitals in Washington state.[22] The active changes that are made using this system focus on the use of checklists, standard orders, education programs, and benchmarks. This program is a successful example of evaluating, evolving and implementing improvements in surgical quality that also led to decreased costs.

When focusing on the issue of transparency, physicians and hospitals are under greater scrutiny, and if surgeons do not participate and help improve upon their own public transparency, it will be done for us, with a greater likelihood that the focus will not be on the relevant clinical issues that affect our patients and their care. It is paramount that the surgeon be involved with all

decisions regarding what data are presented and how it is presented to educate and not scare the public.

Another issue is the changing system of practice, which has led to the proposed creation of, and ongoing discussion of, ACOs or Accountable Care Organizations. The ripple effect of ACOs have already led to the disappearance of some solo physician practices, to small groups coalescing to become larger, or surgeons opting to become employees at a hospital rather than take on the business-side burden of running a practice.

All of this effort ties into reducing costs and improving efficiency by standardizing approaches to disease processes, focusing on improving quality, and maintaining better medical records while continuing to use outcomes and evidence-based results to decrease cost, increase safety and improve efficiency. Reduction of practice variation may begin with the identification of surgical procedures with high volume, high cost, multiple surgeons, and high variability. Within SCOAP, standardization has increased the availability of surgical instruments, improved reliability of the kits, increased the quality and capacity of instrument cleaning, and streamlined process flow. Over time, SCOAP hospitals have demonstrated approximately $2,000 case decrease in cost, compared to non-SCOAP hospitals which have had an increase of about $2,000 case over the same time period.[22]

Destiny is Not a Matter of Chance: Why Advocacy is Crucial?

David Rattner, M.D., Division of Gastrointestinal and General Surgery, Massachusetts General Hospital, Boston, MA

Healthcare reform is not going to go away; current costs are unsustainable and many stakeholders are disenchanted, including employers, patients, and physicians. It is important to understand that the officials we elect to the United States House of Representatives are up for re-election every 2 years and thus are constantly running for office. If you work as a member of a large group, especially one who's members vote, then you will be more likely to have access to your representatives and senators. Congressmen are busy and access often is tied in to your ability to keep the congressman in office. Advocacy requires action or else there will be no results.

Political Action Committees (PAC) were established as a means of contributing directly to candidates. The American College of Surgeons Professional Association PAC (ACSPA) is the seventh largest specialty physician PAC. This statistic is a bit deceiving because relatively few surgeons participate in PACs. For example, only 6.97 % of colorectal surgeons and 4.96 % of general surgeons participate in their PAC. The ACSPA PAC is a non-partisan endeavor; support to candidates is issue-based, rather than party-based. The PAC considers many factors in determining where to allocate support: leadership positions, committee assignments, and prior voting record on issues that are important to surgeons. Even though the ACSPA PAC has been challenged by its low rate of surgeon participation (4 % of members), the PAC has had remarkable success. For example, the ACSPA PAC successfully advocated for a 10 % bonus for rural general surgeons, favorable terms for loan repayment for pediatric surgeons, and redistribution of unused GME slots to general surgery (as well as primary care). The ACSPA PAC has also stopped the $395 annual Medicare application fee, a 5 % tax on cosmetic surgery, and a reduction in surgical fee to pay for a 2 % primary care bonus.

We, as surgeons, can be more effective if we become more active. Contacting our local legislators, giving even a small contribution to our PAC, and participating in discussions about re-design of care and appropriateness are all effective. If surgeon participation in the ACSPA PAC doubled, even more could be accomplished.

In summary, society needs surgeons who understand a wide range of disease processes and can care for common problems. We might call them "General Surgeon:", "Acute Care Surgeon," or "specialist on call for the Emergency Department (ED)," but they will be the surgeons who evaluate patients presenting with abdominal pain, rectal bleeding, or new lumps and bumps. In rural areas, this surgeon may be the first to respond after trauma or assist in deliveries of babies. They will be the surgeons backing up the ED at night, on weekends and holidays, and if we want them available, then these surgeons should be fairly compensated for being "on call" after hours. Ensuring that a general surgeon is there when we need one may mean that we have to increase the number and the size of accredited surgery residencies, which is unlikely given current financial restrictions; increasing flexibility and breadth in general surgery training. However, we might be able to achieve impact by enhancing links with community-based hospitals, seeking loan forgiveness for general surgeons and selecting resident candidates (in part) based on their commitment to general surgery.[23] Our surgical community must move forward, acknowledging that we will make mistakes given the complexity of the issues and their potential solutions. Society should not take for granted that a well-trained surgeon will be there when they need one; instead, healthcare leaders and politicians should ensure that the surgeon workforce is adequate in number and distribution to meet the nation's future healthcare needs.

References

1. Stain S. Update from the American Board of Surgery. in 4th Rural Surgery Symposium. 2009. Mithoefer Center for Rural Surgery, Cooperstown, NY.
2. Sheldon GF. Access to care and the surgeon shortage: American Surgical Association forum. Ann Surg, 2010. 252(4): p. 582-590.

3. Borman KR, Vick LR, Biester TW, and Mitchell ME. Changing demographics of residents choosing fellowships: longterm data from the American Board of Surgery. J Am Coll Surg, 2008. 206(5): p. 782-788; discussion 788-789.
4. United States Department of Commerce. 2012 National Projections. Population Projections 2012; Available from: http://www.census.gov/population/projections/.
5. Marshall E. Report of the Graduate Medical Education National Advisory Committee to the secretary. J Am Optom Assoc, 1982. 53(8): p. 623-626.
6. Physician community requirements in the 21st Century: The 2003 physicians to population ratios. A report by Solucient, LLC., 2004.
7. American Medical Association. AMA Physician Masterfile. 2009 [cited 10/29/2012]; Available from: http://www.ama-assn.org/ama/pub/about-ama/physician-data-resources/physician-masterfile.page.
8. Williams TE, Jr. and Ellison EC. Population analysis predicts a future critical shortage of general surgeons. Surgery, 2008. 144(4): p. 548-554; discussion 554-546.
9. Council on Graduate Medical Education. Summary of Third Report: Improving Access to Health Care Through Physician Workforce Reform: Directions for the 21st Century Council on Graduate Medical Education 1992, U.S. Department of Health and Human Services: Washington D.C.
10. Fischer JE. The impending disappearance of the general surgeon. Jama, 2007. 298(18): p. 2191-2193.
11. American College of Surgeons Health Policy Research Institute. The Surgical Workforce in the United States: Profile and Recent Trends, 2009.
12. Valentine RJ, Jones A, Biester TW, Cogbill TH, Borman KR, and Rhodes RS. General surgery workloads and practice patterns in the United States, 2007 to 2009: a 10-year update from the American Board of Surgery. Ann Surg, 2011. 254(3): p. 520-525; discussion 525-526.
13. Council on Graduate Medical Education. About the Committee. 2012 [cited May 15, 2012]; Available from: http://www.hrsa.gov/advisorycommittees/bhpradvisory/cogme/About/index.html.
14. Reisdorff E, Nossett A, Robertson R, Parekh A, Shu J, Thomas W, Wen L, and Council on Graduate Medical Education. Eighteenth Report of COGME: New Paradigms for Physician Training for Improving Access to Health Care, 2007, U.S. Department of Health and Human Services: Rockville, MD.
15. Association of American Medical Colleges. Medical School Enrollment Plans Through 2013: Analysis of the 2008 AAMC Survey, C.f.W. Studies, Editor 2009: Washington D.C.
16. Charles AG, Walker EG, Poley ST, Sheldon GF, Ricketts TC, and Meyer AA. Increasing the number of trainees in general surgery residencies: is there capacity? Acad Med, 2011. 86(5): p. 599-604.
17. American Association of Colleges of Osteopathic Medicine. 2011-2012 Osteopathic Medical College Total Enrollment, by State of Legal Residence, American Association of Colleges of Osteopathic Medicine, Editor 2012: Chevy Chase, MD.
18. Berwick DM, Nolan TW, and Whittington J. The triple aim: care, health, and cost. Health Aff (Millwood), 2008. 27(3): p. 759-769.
19. Hall BL, Hamilton BH, Richards K, Bilimoria KY, Cohen ME, and 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): p. 363-376.
20. Fraher E, Knapton A, Sheldon G, Meyer A, and Ricketts T. Projecting surgeon supply using a dynamic model. Ann Surg, 2013. 257(5): p. 867-872.
21. Belsky D, Ricketts T, Poley S, Gaul K, Fraher E, and Sheldon G. Surgical Deserts in the US: Places Without Surgeons, 2009, American College of Surgeons Health Policy Research Institute: Chapel Hill, North Carolina.
22. Scoap Collaborative, the Writing Group for the Scoap Collaborative, Kwon S, Florence M, Grigas P, Horton M, Horvath K, Johnson M, Jurkovich G, Klamp W, Peterson K, Quigley T, Raum W, Rogers T, Thirlby R, Farrokhi E, and Flum D. Creating a learning healthcare system in surgery: Washington State's Surgical Care and Outcomes Assessment Program (SCOAP) at 5 years. Surgery, 2012. 151(2): p. 146-152.
23. Polk HC, Jr., Bland KI, Ellison EC, Grosfeld J, Trunkey DD, Stain SC, and Townsend CM. A proposal for enhancing the general surgical workforce and access to surgical care. Ann Surg, 2012. 255(4): p. 611-617.