Chapter 12
Providing Surgical Care to an Aging Population: Implications for the Surgical Workforce

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Introduction

The demographic trends underlying the "aging population" have already been discussed in Chap. 12. As a result of increasing life expectancy and the aging of the baby boomers, the United States (US) population will see a dramatic increase in the number of older individuals. Between 2010 and 2030, those aged 65 years and older are projected to rise by 78%, an absolute increase of over 30 million individuals. These unprecedented changes in the demographics of the US population will lead to significant growth in the demand for surgical treatment.

This chapter comes with an acknowledgement. In the interest of simplicity, we examine these trends within the context of the US population only. Furthermore, we focus more on general surgery and its subspecialties than on other areas of surgical specialization. This is in the interest of developing a succinct, circumscribed report. The analyses described here are easily applicable within other fields of medicine, as well as to other countries.

Another acknowledgement is also important. This chapter could easily be its own textbook. In selecting which points should be made, we focus on a survey of existing opinions and concepts that are driving policy. We will also offer some original analysis regarding how the aging population will affect the delivery of surgical treatment. Our hope is at the end of this chapter, the reader will be familiar with the methods used to forecast the impact of the aging population on the healthcare delivery system, and be able to differentiate the relative importance of the various factors that will drive health care expenditure in the immediate and more distant future.

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Older Individuals in the US Population: Disproportionately High Use of Resources

In general, older individuals use medical and surgical services at higher rates than do younger individuals. To illustrate and characterize this fact, we will rely on analyses of the National Hospital Discharge Survey (NHDS), a data source which deserves at least a brief explanation. Since 1965, the National Center for Health Statistics has conducted an annual survey (sampling) of domestic discharges. Each year, over 350,000 discharges from approximately 500 hospitals within the US are sampled, and the sampling strategy is designed to yield a dataset that is representative of the universe of domestic discharges [1]. The NHDS reports specific information about each discharge, including age, gender, race/ethnicity, diagnoses, procedures, diagnosis-related grouping (DRG) admission source (emergency room, home, etc.), and admission type (emergency, elective, etc.). At several points in this chapter, we will rely on analyses of the NHDS to give a quantitative analysis of historical and projected trends in the patterns of hospital-based health care delivery in the US.

Hospital-Based Care

According to data from the US census, in 2006, individuals over the age of 65 comprised 12.5% of the US population [2]. However, according to data from the NHDS, individuals over the age of 65 were responsible for:

- 32% of cholecystectomies
- 38% of hospitalizations
- 43% of hospital days of care
- 54% of colon resections
- 55% of total hip replacements
- 60% of total knee replacements

This disproportionate use of services can be considered in terms of an incidence rate curve, demonstrating the likelihood of an individual in the population requiring a specific

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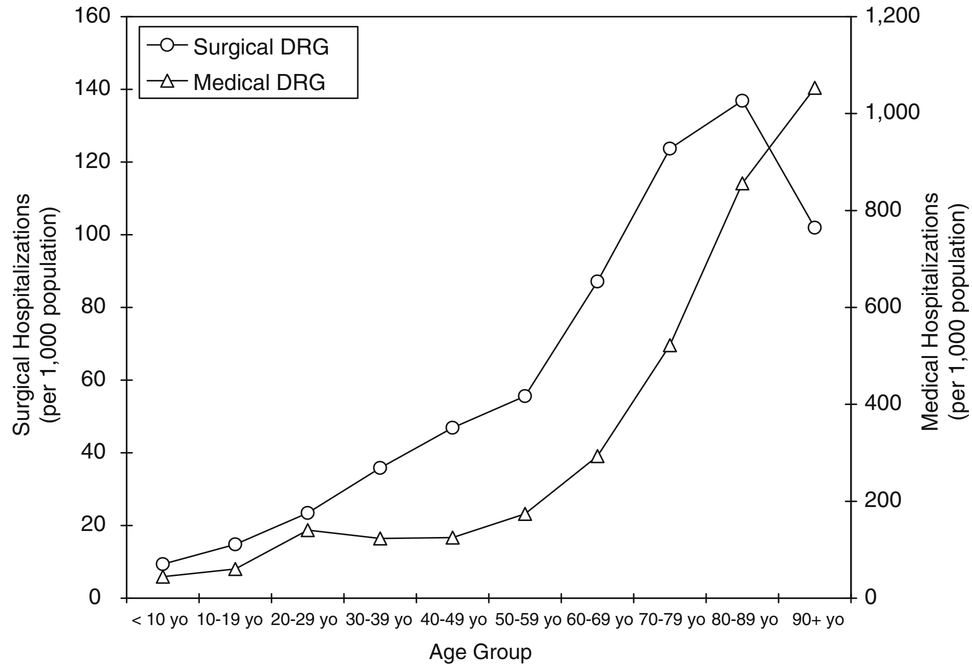


Figure 12.1 Incidence rate curves: admissions for medical vs. surgical DRGs.

type of hospital-based medical or surgical service. Figure 12.1 represents such an analysis based on data from the 2006 NHDS. We categorized admissions as "surgical" or "medical" based on DRG, according to nomenclature used by the Centers for Medicare and Medicaid Services (CMS) [3]. Admissions for children in their first year of life or those related to childbirth were excluded.

These incidence rate curves clearly demonstrate the difference in the rates at which younger vs. older individuals are hospitalized. Compared with an individual aged 40–50, an individual aged 70–79 is 2.6 times more likely to be hospitalized for a surgical cause and 4.2 times more likely to be admitted for a medical reason. The duration of hospitalization also varies widely across different age groups, with average lengths of stays (LOS) being higher in older individuals admitted for both surgical and medical DRGs (Fig. 12.2).

Inpatient Procedures

The demand for specific types of inpatient surgical procedures can also be conceptualized as an incidence rate curve. Several examples are illustrated below, namely for knee replacement, coronary artery bypass graft (CABG), colectomy, cholecystectomy, carotid endarterectomy (CEA), and hysterectomy (vaginal or trans-abdominal) (Fig. 12.3). These curves illustrate very clearly the higher rates at which older individuals undergo surgical treatment. In fact, for each of these procedures (except for hysterectomy), individuals in their eighth or ninth decade of life have the highest frequency of surgery.

Outpatient Procedures

Outpatient surgical procedures are, in general, also performed much more commonly in older individuals. The following graph (Fig. 12.4) examines rates of seven of the most frequently performed outpatient procedures based on data from the State of Florida [4]. Two procedures – myringotomy tubes and tonsillectomy/adenoidectomy – are performed more commonly in younger patients and less so in older individuals. For the remaining five procedures, the age range with the highest rates of surgery is individuals aged 60 years and older. This is particularly true for cataract operations, which could not be included in the figure below for reasons of scale. The rate of cataract surgery among individuals aged 70–79 is 74 per 1,000 population, greater than the other seven procedures combined.

Older Patients are Different

In this section, we will explore how an older domestic population will affect not only the numbers of procedures, but also the types of procedures and the intensity of care provided for them.

A brief examination of the "top ten" surgical procedures performed on patients over vs. under the age of 65 tells some of this story. For this analysis, we once again turn to data from the NHDS and examine only the primary procedure performed during each hospitalization [5]. For patients under the age of 65, the most commonly performed procedures were hysterectomy (abdominal), followed by cholecystectomy then

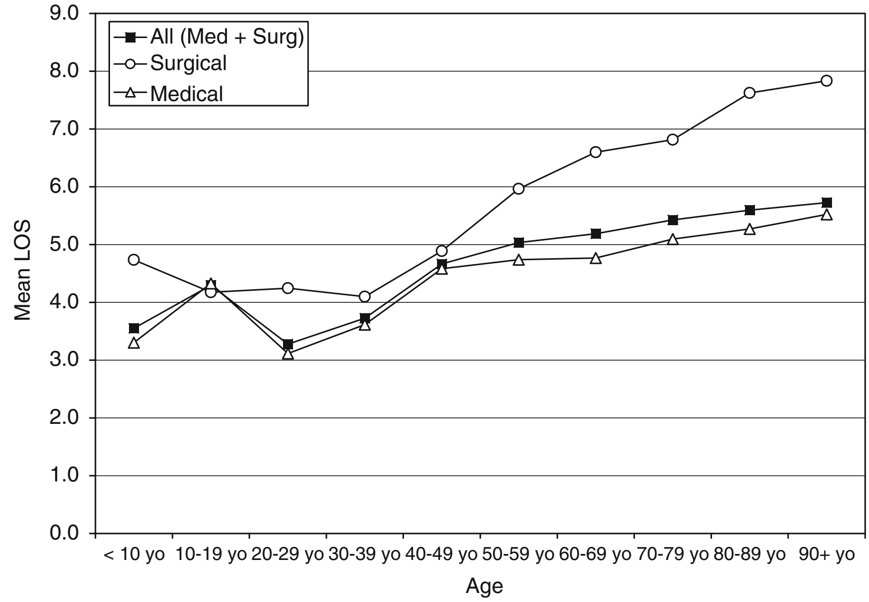


Figure 12.2 Mean LOS: medical vs. surgical DRGs.

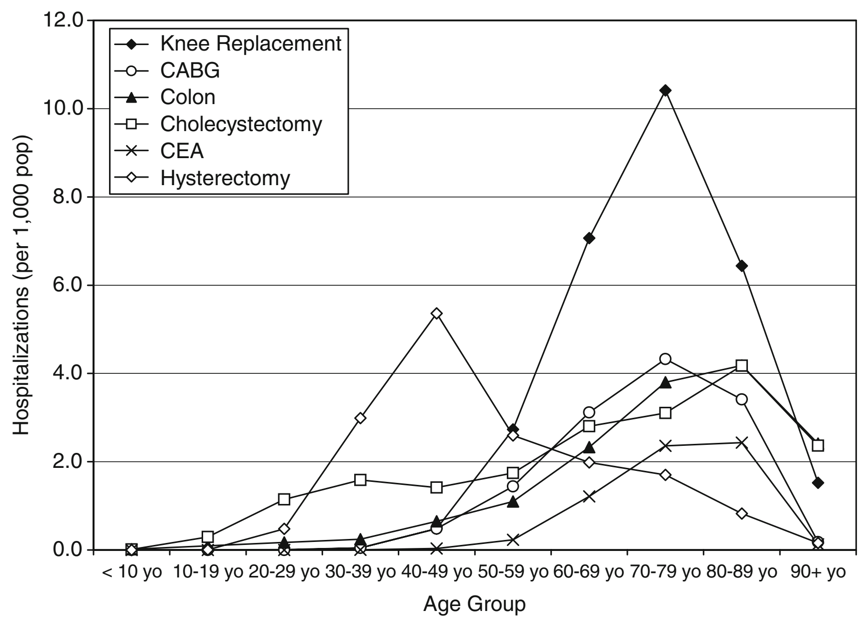


Figure 12.3 Incidence rate curves: commonly performed inpatient procedures.

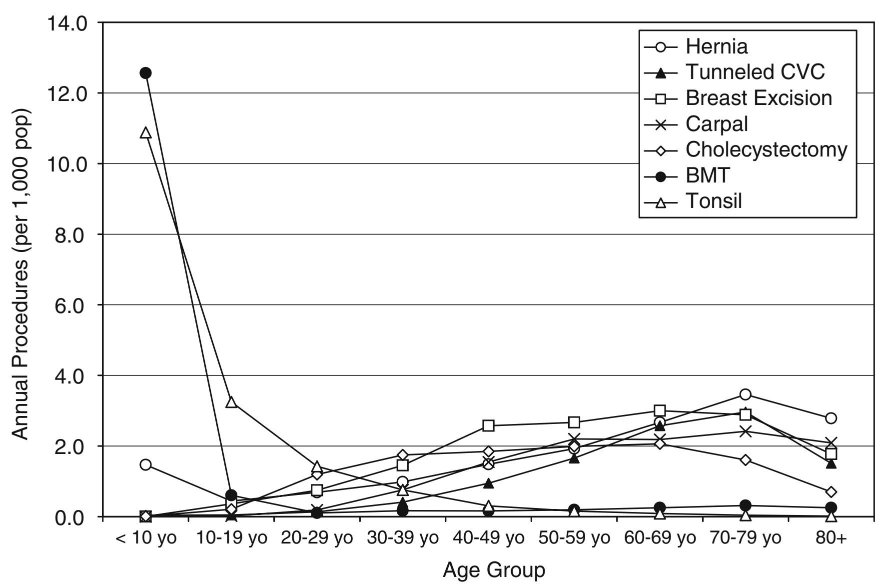


Figure 12.4 Incidence rate curves: commonly performed outpatient procedures.

knee replacement. For older patients, the top four inpatient procedures were all orthopedic. Seven out of these top ten procedures were orthopedic or neurosurgical in nature.

In addition to generating an increased demand for surgical procedures, the aging population presents a more fragile population of patients (Tables 12.1–12.3). As shown below in Table 12.3, older patients require a greater amount of care. The average length of stay was higher for older patients (4.8 vs. 3.3), and the likelihood of an in-hospital myocardial infarction (MI) was approximately ten times greater (0.7 vs. 0.07%). The greatest difference in outcomes is mortality, with patients over the age of 65 having an in-hospital mortality rate nearly 15 times higher (1.1 vs. 0.07%). Longer lengths of stay and higher rates of myocardial infarction and postoperative mortality only tell part of this story. In order to minimize the impact of medical comorbidity on peri-operative outcomes, surgeons will need to work closely with non-surgeon physicians to optimize medical management. There is already evidence that medical hospitalists are increasingly involved in the care of surgical patients. In a recent analysis of Medicare claims data, Kuo et al. found a more than fivefold increase in the percent of surgical admissions that involved care from a medical hospitalist [6]. A new paradigm of inpatient care may be emerging, with surgeons and non-surgical physicians working together to manage patients who are elderly and/or morbid.

As the number of elderly individuals in the US population continues to increase, another area that will require focused attention is the clinical effectiveness/appropriateness of different types of treatment in older patients. Many types of major surgery that historically were considered too risky to undertake in elderly patients are now widely considered safe [7–9]. The bias against aggressive surgical treatment for patients considered empirically “too old” appears to be diminishing, and the rates at which elderly individuals are undergoing several types of major surgical procedures are increasing [10]. There is still, however, evidence that elderly patients are under-treated for many types of conditions, especially oncologic diseases [11–13]. These findings are behind a movement advocating more focused research on clinical outcomes in elderly patients [14].

Table 12.1 Top ten procedures performed in individuals <65 years old

ICD code	Procedure description	Procedures in 2006
68.4	Total abdominal hysterectomy	418,588
51.23	Laparoscopic cholecystectomy	386,444
81.54	Total knee replacement	309,341
47.01	Laparoscopic appendectomy	288,023
47.09	Other appendectomy	212,380
79.36	Operative reduction/internal fixation tibia/fibula	157,726
81.51	Total hip replacement	154,469
68.59	Other vaginal hysterectomy	148,806
68.51	Laparoscopically assisted vaginal hysterectomy	91,169
45.76	Sigmoidectomy	65,892

Table 12.2 Top ten procedures performed in individuals ≥65 years old

ICD code	Procedure description	Procedures in 2006
81.54	Total knee replacement	574,021
79.35	Open reduction internal fixation	239,019
81.52	Partial hip replacement	221,981
81.51	Total hip replacement	218,685
51.23	Laparoscopic cholecystectomy	178,053
38.12	Endarterectomy	123,047
79.15	Operative reduction/internal fixation femur	114,949
45.73	Right hemicolectomy	96,556
03.09	Other exploration and decompression of spinal canal	76,415
81.08	Lumbar and lumbosacral fusion, posterior technique	60,645

Table 12.3 Top ten procedures performed in individuals of all ages

			Patients <65 years			Patients ≥65 years		
ICD code	Procedure description	Procedures 2006	Mean LOS	% Mortality	% MI	Mean LOS	% Mortality	% MI
81.54	Total knee replacement	195,453	3.7	0	0	3.9	0.2	0.3
51.23	Laparoscopic cholecystectomy	138,699	3.2	0.05	0.03	5.4	0.03	0.2
81.51	Total hip replacement	93,636	3.8	0	0.02	3.9	0.2	0.2
47.01	Laparoscopic appendectomy	75,546	2.3	0	0	3.5	0	0.3
79.35	Operative reduction/internal fixation femur	63,882	5.5	0.3	0	6.3	0.5	0.1
47.09	Other appendectomy	60,345	3.5	0.03	0.2	6.0	0.3	2.6
81.08	Lumbar/lumbosacral fusion, posterior technique	54,270	4.1	0	0.07	5.2	0	0.1
79.36	Operative reduction/internal fixation tibia/fibula	53,028	4.3	0.4	0.4	4.6	0.8	1.4
81.52	Partial hip replacement	49,842	6.1	0.2	0	6.5	0.2	2.2
68.59	Other vaginal hysterectomy	41,796	1.6	0	0	2.2	0	0
Unadjusted totals		826,947	3.3	0.07	0.07	4.8	1.1	0.7

Current Capacity

As the number of older individuals in the US rises, it should be intuitive that the use of medical resources will increase at a rate faster than population growth. Before discussing the impact of *forthcoming* demographic changes on the surgical workforce, we will first consider the capacity of the *current* health care delivery system to provide surgical care. In doing so, we examine capacity in terms of two complementary components – physician workforce and hospital infrastructure.

Physician Workforce Capacity

Two main types of research have emerged to gauge the adequacy of the current physician work force relative to population-based demand, yielding conflicting results. The first type is a "macro" analysis, examining regional relationships between physician density and quality of care. A classic example of this type of research was performed by Baicker et al., who analyzed state-level measures of the quality of medical care provided to Medicare recipients and found *poorer* quality of care delivered to patients in states with *higher* per capita Medicare expenditures and physician density [15]. Furthermore, they found that quality of care was proportional to the density of general practitioners and *inversely* proportional to the concentration of specialist physicians. These findings were refuted by Cooper et al. who examined within-state variations, and concluded that states with more spending and more physicians – both generalist and specialists – had better quality of care [16, 17].

The second type of research examines the ability of the health care workforce to meet the demands of the regional population at a "micro" level. Several studies have examined hospital-based care, using the ability of emergency departments (EDs) to obtain consultations from surgical specialists as a measure of access to care. In a study of ED directors at over 4,000 US hospitals, the American College of Emergency Physicians found that 73% of EDs had problems with inadequate on-call coverage by specialist physicians [18]. Also, this figure had increased from 67% only the previous year. Difficulties with obtaining specialist consultations are also documented as worsening, both in terms of the ability to access on call specialists, and in the ability of EDs to initiate transfers to hospitals where a higher level of care can be provided [19]. Areas with lower mean zip code income had a lower likelihood of timely response to a request for surgical consultation [20].

If the network of available surgical specialists begins to fray, and access to care is compromised, how will we know? Is a state-level analysis sufficiently sensitive to capture life-threatening shortages in the availability of surgeons capable and willing to tackle acute surgical problems in the middle of the night? In considering these issues, it should be readily apparent that the areas of the country that are likely to experience the most acute shortages are rural areas of the US. Within the US, rural areas represent 75% of the country's land mass and 17–20% of the population, but only 10% of the domestic workforce of general surgeons [21]. Two recent front-page articles, one in the *Washington Post* and one in the *Wall Street Journal*, have highlighted the difficulties facing rural general surgeons and their surrounding communities [22, 23]. The departure of these physicians from the workforce – resulting either from harsh conditions/job dissatisfaction or simple age-related attrition – stands to have a significant impact on patient access to care and the financial viability of community hospitals [21, 24].

Several physician leaders within the field of general surgery have called attention to the growing problem of surgeon shortages in rural areas [24–28]. We refer the reader to this literature for a thorough discussion of this emerging issue, and plans to address it. In considering the plight of the rural communities, however, it is important to bear in mind that the rural surgical workforce does not exist separately from the non-rural surgical workforce, but rather in equilibrium with it. The acute shortage of surgeons in these areas is probably best considered as the first manifestation of a growing national problem.

Hospital Capacity

The ability of the existing hospital infrastructure to meet increased demand for inpatient care is an often-overlooked consideration. According to 2007 data from the American Hospital Association, there are currently 4,897 hospitals and 800,892 staffed hospital beds in the US [29]. Longitudinal trends in the number of beds and number of beds per 1,000 population between 1981 and 2006 are shown in Fig. 12.5.

Over the last decade, the use of hospital-based care has remained remarkably constant, in terms of age-specific rates of hospitalization (Fig. 12.6a). The annual number of hospitalizations and inpatient days of care used per year in the US between 1996 and 2006 are presented using data from the NHDS (Fig. 12.6b). Forecasts between 2006 and 2030 were calculated based on 2006 patterns of hospitalization in terms of age-specific rates of admission and lengths of stay.

Between 1996 and 2006, numbers of hospitalizations increased by 12.8% and inpatient days of care by 5.0%. The differential rates of growth are explained by an overall trend in decreased LOS. Based on the patterns of hospitalization from 2006, between 2006 and 2030 we forecast that the number of annual hospitalizations will increase by 39% and days of inpatient care by 43% (Fig. 12.6b).

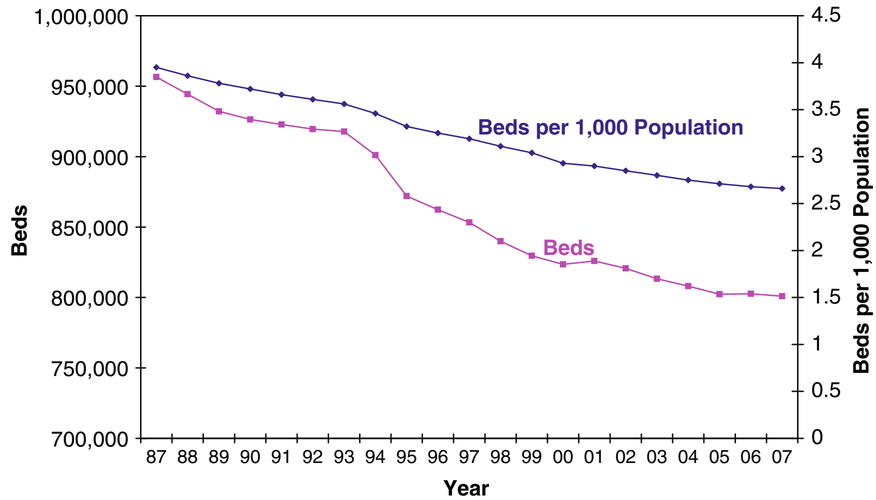


Figure 12.5 Number of hospital beds in the US: 1987–2007 (data from the American Hospital Association Annual Survey, 2007, for community hospitals, Avalere Health, Washington, DC).

Given that the number of beds per population is decreasing and the population-based demand is increasing, the capacity of the current hospital network to cope with future growth in the numbers of domestic hospitalizations is worthy of investigation. At the time of writing this chapter, the authors know of no comprehensive studies of the occupancy rates within US hospitals. One study of New Jersey hospitals found occupancy rates on average well below 80%, implying ample capacity [30]. Are these levels of utilization representative of other communities in the US? The ability of hospitals to handle growing demand for inpatient care engendered by the aging population needs to be examined at every level.

Forecasting Utilization

The fact that older individuals use more health care resources than younger individuals is important, but other important forces also drive changes in utilization of medical services. These forces include population growth, changes in health care delivery, and economic expansion. In the past, several approaches have been applied to project the amount by which population-based use of medical resources will increase in the future. The methods behind these approaches are rooted in varying methodologies, and have yielded conflicting results over time. Broadly speaking, models used in forecasting medical expenditure can be categorized as needs-based, demands-based, or economic in terms of the approach taken.

Needs-Based Models

A needs-based model is predicated on estimating the population-based need for medical services and applying this estimate of need to the population as it will be in the future. For the purpose of this discussion, we will first define the "need" for medical services based on an existing definition:

> That quantity of medical services which expert medical opinion believes ought to be consumed over a relevant time period in order for its members to remain or become as "healthy" as is permitted by existing medical knowledge [31].

Translating a needs-based model into prediction requires two main steps. First, an epidemiological estimate of disease frequency is developed. Second, the amount and type(s) of care necessary to adequately treat the disease is compiled. A needs-based model can also be "adjusted" to reflect predicted changes in either of the two elements of the model. The Graduate Medical Education National Advisory Committee (GMENAC) report, published in 1980, is an example of a needs-based approach [32]. In the GMENAC report, a panel of medical experts (6–10 for each specialty) estimated the profile of care required by the general population. The estimation was targeted at predicting patterns of care as they "should be," rather than as they actually were at some baseline point in time. Based on this needs-based model, the GMENAC report suggested that by the year 2000, there would be approximately a 25% physician surplus.

Inherent in any needs-based model is a prediction regarding what patterns of treatment will be in the future. This type of estimation can be a strength or a weakness, depending on its ability to move a prediction model in a way that makes it more or less accurate. While in retrospect it is easy to dismiss the GMENAC model as poorly conceived, in its time this effort was a significant driver of health policy.

Demands-Based Models

A demands-based model is based on interpreting the desires or "wants" of a population, and placing these motivations in the context of market forces, especially price. We defer, once

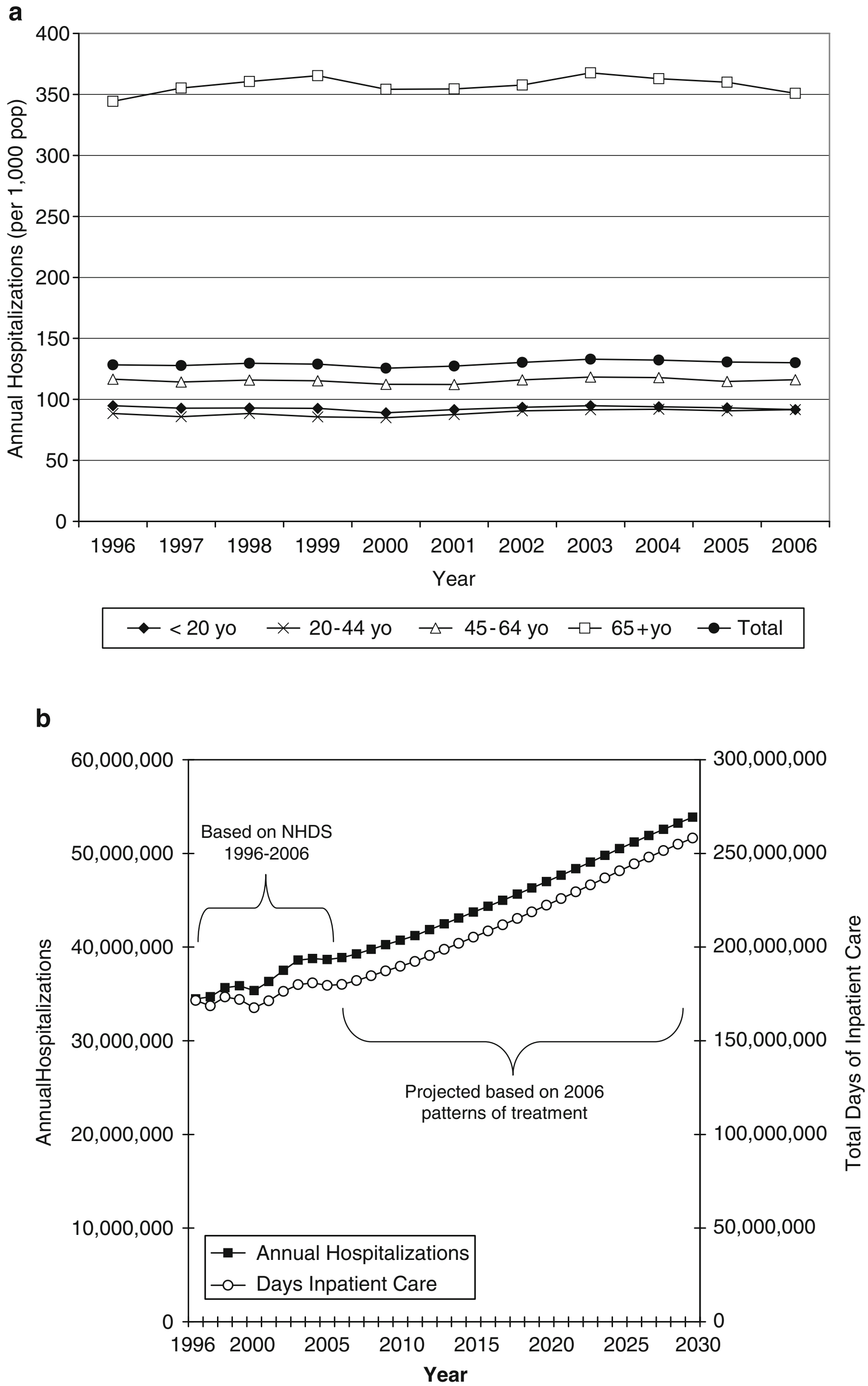
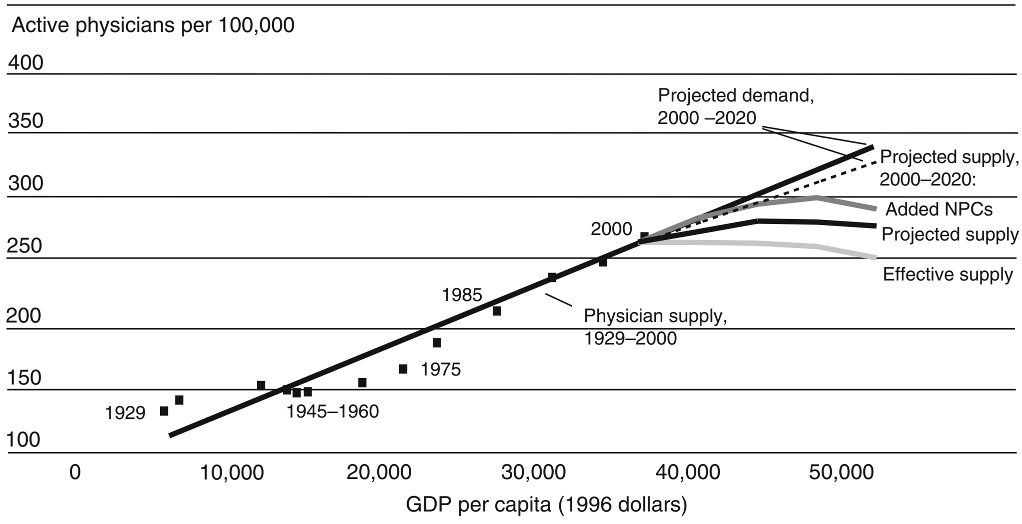


Figure 12.6 (**a**) Age-specific rates of hospitalization: 1996–2006; (**b**) annual hospitalizations and days inpatient care: 1996–2030.

again, to a preexisting definition for "demand" in order to ground this discussion:

A multivariate functional relationship between the quantities of medical services that its members desire to consume over a relevant time period at given levels of prices of goods and services, financial resources, size and psychological wants of the population as reflected by consumer tastes and preferences for (all) goods and services [31].

Generating a demands-based model for predicting use of medical services is relatively straightforward, and relies on two core components. First, rates of surgical procedures can be calculated based on any one of a number of existing data sources. Second, these rates can then be applied to forecasted population changes in order to project trends in the use of different types of surgical procedures. A demands-based approach benefits from simplicity and objectivity. The major



Sources: Physician supply: R.I. Lee and L.W. Jones, *The Fundamentals of Good Medical Care* (Chicago: University of Chicago Press, 1933); W.H. Stewart and M. Pennell, "Health Manpower, 1930–75," *Public Health Reports* 75, no. 3 (1960): 274–280; American Osteopathic Association; and Bureau of Health Professions. Population: Bureau of the Census. Gross domestic product: Bureau of Economic Analysis. Supply projections based on authors' model; see Note 4 in text.
Notes: "Physician supply 1929–2000" includes active physicians only ($r^2 = 0.94$). "Projected supply" includes all active physicians. "Effective supply" represents the number of active physicians reduced by the decrements in work effort associated with increasing numbers of female and older physicians in the workforce. "Added NPCs" represents the sum of "effective supply" plus the incremental contributions of nonphysician providers (NPCs). Per capita GDP is expressed in chained 1996 dollars. "Physician demand" is projected based on average annual GDP growth rates of 1.5 percent (dotted rule) and 2 percent (continued solid rule).

Figure 12.7 Physician supply and gross domestic product, 1929–2000 and projected to 2020 (from Cooper et al. [34]).

shortcoming of this approach stems from the underlying assumption that per capita demand will remain constant over the time period of interest.

In 1989, a private consulting firm (ABT Associates) was contracted by the Bureau of Health Professions to conduct a follow-up to the GMENAC study. The methods used in this report were demands-based, and findings included a projected increase in the use of general surgical care of 32.7% between 1990 and 2010. We published the results of a similar type of model in 2003, and found a projected increase in the demand for general surgical procedures of 31% between 2001 and 2020 [33].

Economic Models

Economic models add another important dimension to the science of forecasting growth in the use of medical resources. The arguments underlying a need to consider economic factors are elegant. In the US, the per capita use of medical resources has risen steadily over time, and this rate of rise is linear when compared with increases in gross domestic product (GDP). Economic models attempt to account for the impact of economic factors, and incorporate projected growth in GDP into a predictive model. The use of economic models in physician workforce forecasts has been predominantly advocated by Cooper et al., and published initially in 2002 [34]. Their approach, termed a "trend model," incorporates four factors (1) economic expansion, (2) population growth, (3) physician work effort, and (4) services provided by non-physician clinicians (NPCs) (Fig. 12.7).

This model is notably different from demands-based and needs-based models in that it (1) defines and quantifies a direct relationship between economic expansion [gross domestic product (GDP)] and physician supply, and (2) assumes that this relationship will remain constant into the future. An economic model also has special usefulness in characterizing the relationship between economic growth and specific subtypes of physician services. Based on a cross-sectional analysis of States (in the US) in 1995, this model documents a relationship between regional per-capita income and the supply of three types of physicians: general practitioners, surgical specialists, and medical specialists (Fig. 12.8). The implication of this finding is that continued economic growth will lead to a relatively greater growth in the demand for medical and surgical specialists than for general practitioners.

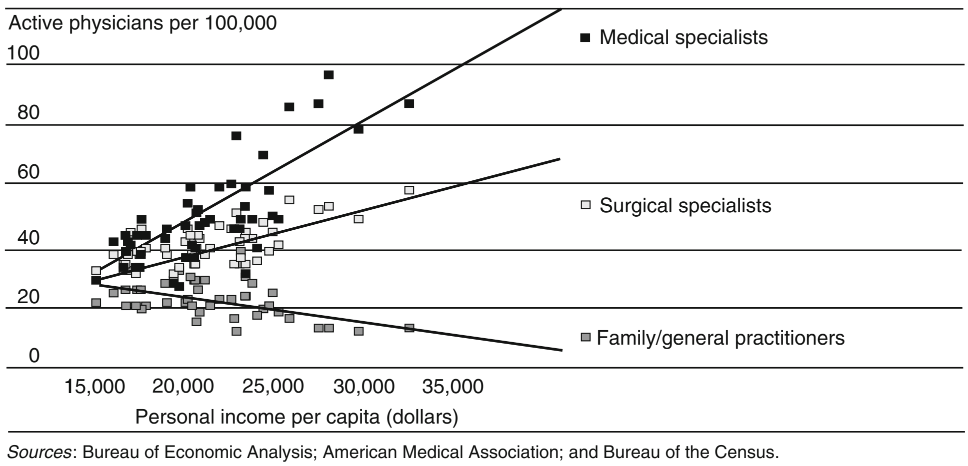


Figure 12.8 Physician supply in States, by major specialty group and State per capita income, 1995 (from Cooper et al. [34]).

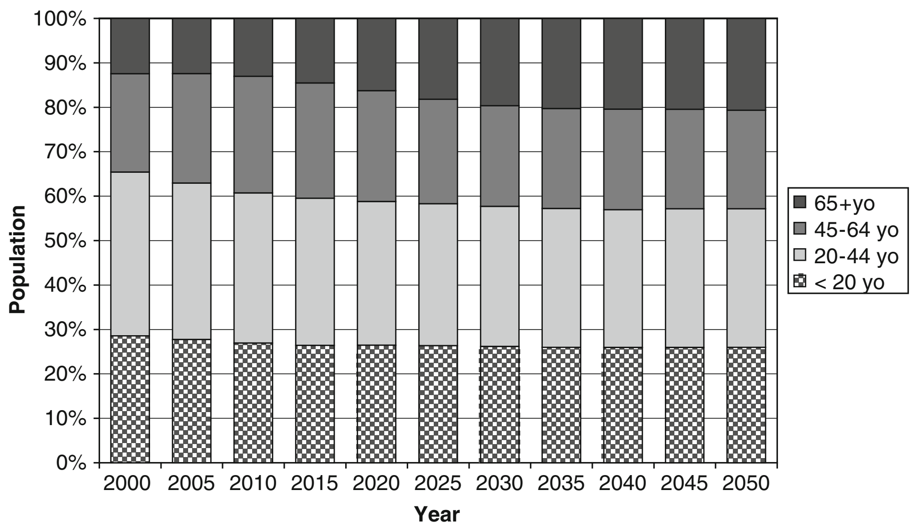


Figure 12.9 US population age distribution: 2000–2050.

In forecasting the demand for physician services, economic models make an explicit assumption which might also be considered a weakness – that economic expansion will continue at rates that are roughly similar to those in recent history. At the time of the writing of this chapter, that assumption might be called into question. In a period of lesser economic growth or even recession, the actual demand for physicians (according to this type of model) would be lower than forecasted. It is also notable that this model explicitly fails to incorporate any acknowledgement of the aging of the US population. The extent to which the aging of the population is a significant driver of future expenditures is a topic of great debate. Several notable economists have argued that population aging is *not* a primary driver of growth in expenditures [35, 36]. Their argument is based on demonstrating that the demographic profile of the US population will not actually change dramatically in the coming decades (Fig. 12.9).

While at first glance, the demographic shift toward an aging population might appear minimal or modest, this type of display hides a subtle but important truth. Based on figures from the US census, in 2000 12.4% of the US population were aged 65 years or older; by 2030, this figure will increase to 19.7%, and between 2030 and 2050 the proportion of the population 65 years and older will remain stable at approximately 20%. Meanwhile, the overall US population is forecasted to increase by 29% between 2000 and 2030, and 49% by 2050. In the future, what proportion of growth in medical expenditures can be accounted for by population growth as opposed to population aging?

In Fig. 12.10a, b, we address this question looking at medical/surgical admissions and procedures using a forecasting method that is based on data from the 2006 NHDS. During a 25-year period that sees 22% growth in the US population, there will be a projected 44% increase in medical admissions and a 38% increase in surgical admissions for

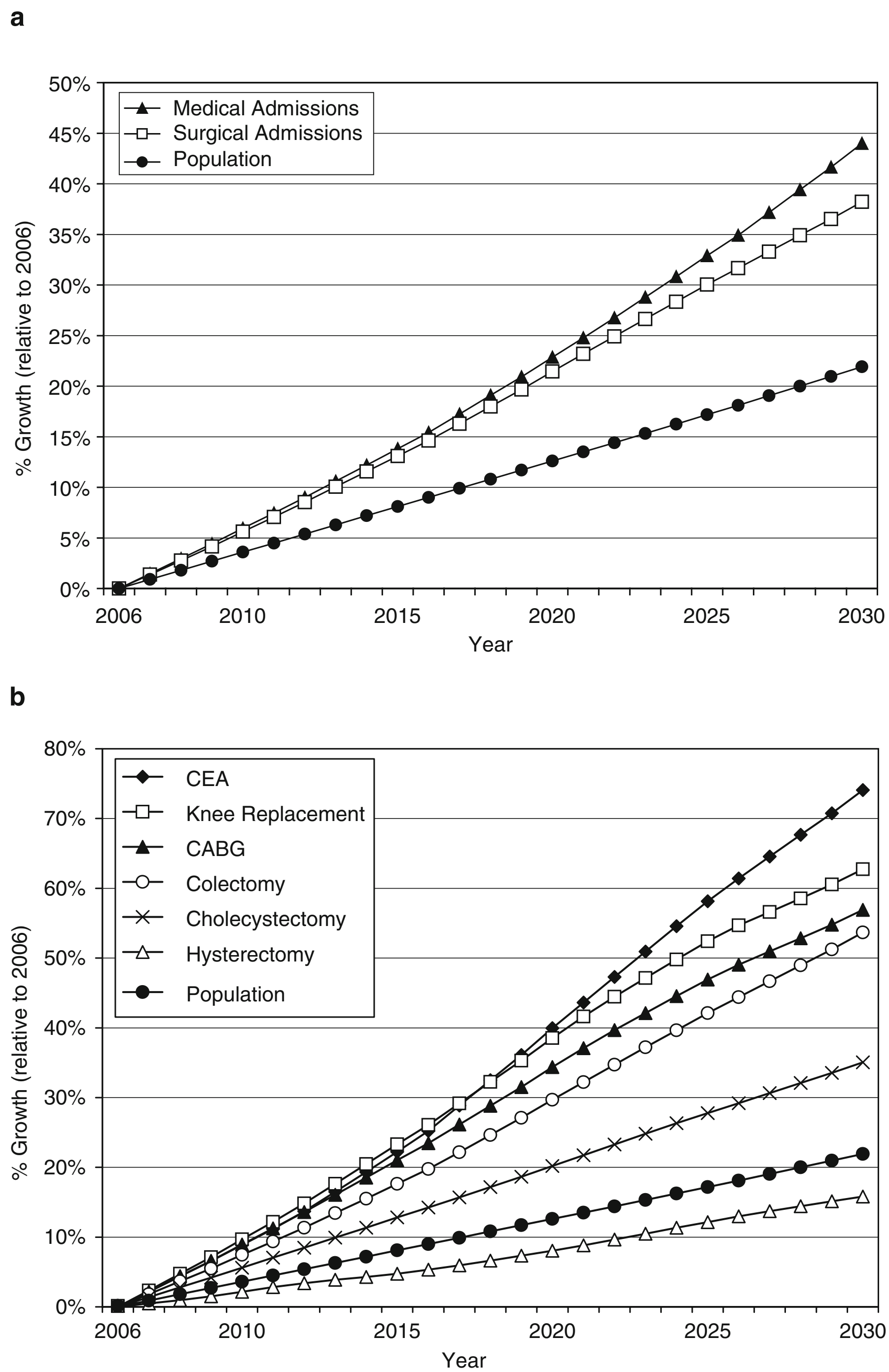


FIGURE 12.10 (**a**) Projected growth in population and medical vs. surgical admissions: 2006–2030; (**b**) projected growth in selected surgical procedures: 2006–2030.

hospital-based care. Growth in specific surgical procedures varies widely, from 16% (hysterectomy) to 74% (CEA). In general, these rates of procedure-based growth are significantly greater than simple population growth.

So why do economists de-emphasize the aging of the US population in their forecasting models? The answer may lie in that their perspective encompasses a more global view of health care finance. In recent years and in the near future, domestic health spending has grown by an estimated 6–7% per year [37–39]. From the perspective of national policy planning, it is clear that population expansion and aging are not the only (and perhaps not even one of the most important) drivers of growth in expenditures. This point of view – while valid – has the potential to overlook problems related to the adequacy of the supply of specific types of physicians relative to the projected demand for their care.

The Surgical Workforce

The forecasting models described above all predict a significant increase in the demand for health care services. These models tend to group all physicians together in considering workforce, or at best into "surgical specialists." In this section, we will describe the training pipeline that produces physicians in the US, and examine the general surgery workforce as a case in point.

Training: Medical Schools

Medical education is the first gateway through which physicians must pass en route to independent practice, and there are finite means through which this can occur. Between 1980 and 2005, the number of graduates from domestic medical schools (allopathic plus osteopathic) has remained at approximately 16,000–18,000 per year [40]. A significant number of physicians practicing in the US did not attend a domestic medical school. Physicians who graduated with a medical degree from a school listed in the World Health Organization directory of medical schools or the Foundation for the Advancement of International Medical Education and Research (FAIMER) are eligible to obtain licensure within the US. In 2007, 29% of entrants into graduate medical education (GME) training programs were international medical graduates (IMGs) [41]. The Association of American Medical Colleges recently recommended increasing the number of medical school positions in the US by 30% in the decade starting 2005 [42]. Recent projections place the estimated actual growth in positions at 21% [43].

Residency Training

Graduate (residency) medical education is funded both directly and indirectly through a variety of sources, most notably Medicare. The adequacy of these training programs is supervised by the American Council for Graduate Medical Education (ACGME) through Residency Review Committees (RRCs). The vast majority of physicians working in the US are trained through an ACGME-accredited residency program, and gauging the output of this pipeline over time is important to understand the current and future physician workforce.

Between 1980 and 1993, the number of residency training positions in the US increased from 61,819 to 97,370 (58%), a rate significantly more rapid than population growth [44]. By the early 1990s, however, general and academic consensus was that a period of physician oversupply was imminent [45, 46]. The Balanced Budget Act (BBA) of 1997 placed limits on the number of such training positions that would be funded by Medicare, and this cemented a halt in the increase of graduate medical education. In the 10-year period after the passage of the BBA, there has been an 8% increase in training positions, primarily the result of increased trainees, but also due to increased sub-specialization and longer training programs [41].

The number of fully-trained physicians that can be trained each year in the US is a function primarily of the number of residency training positions. An increase in the number of qualified domestic medical school graduates without accompanying growth in residency slots will only result in a lower proportion of IMGs in domestic GME programs or a body of domestic graduates who are unable to find appropriate training positions. Despite the significant movement toward expanding the number of medical school slots, there has not yet been a co-existing mandate to increase GME expenditures or positions. In the context of a recessionary economy, it seems unlikely that Federal spending on GME will increase.

Work Effort

The work output per surgeon is another important element of the workforce equation. The economic model developed by Cooper et al. forecasts a decrease in work effort over the next 15–20 years as a result of an aging surgical workforce and the rising number of female physicians [34]. They assumed a reduction in work effort of 10% for physicians aged 55–65, and 20% for those aged >65, and that female physicians work output is 20% lower than male physicians. Within their model, these assumptions resulted in a net 5% reduction in overall physician effort in 2010, and 10% in 2020 (relative to 2000).

Another important factor affecting physician work effort/efficiency is the shifting paradigm of work hours during surgical training. In July 2003, the ACGME issued standards for all accredited residency programs, mandating an 80-h work week. Most recently, in December 2008, the Institute of Medicine (IOM) released a report entitled "Resident Duty Hours: Enhancing Sleep, Supervision, and Safety" [47]. While this report did not go beyond the ACGME standards in further limiting the number of hours worked by residents, it advocated significant changes to how those hours should be structured. As part of this report, the IOM commissioned an analysis of how many additional physicians would be required to meet staffing needs if its recommendations were implemented. This analysis found a need for an additional 5,001 attending physicians and 8,247 resident physicians.

It may also be a matter of time before the hours worked by surgeons in practice are reduced. This may be a result of the decreased hours in training carrying over into a desire by graduates to work less, or a more global shift on the part of medical students towards a desire for a controllable lifestyle [48, 49]. Another emerging trend that may affect the work output per surgeon in the US is the trend away from independent physician practice. According to data from the Center for Studying Health System Change, in 1996–1997 the proportion of surgical specialists who are full or partial owners of their practice was 75.5%, but by 2004–2005 this figure had decreased to 68.4% [50]. How does a shift away from independent practice affect overall clinical productivity? The relative productivity of surgeons in independent practice compared with surgeons in other types of practice environments is unknown. Regardless of the impact of this emerging trend on physician productivity, the loss of surgeon practice autonomy may have significant implications for the field which should be addressed at the highest level of leadership.

The aging of the surgical workforce is a significant challenge not only in terms of declining work effort, but also in terms of exit from the workforce. According to data from the American Medical Association, over 40% of active general surgeons, urologists, thoracic surgeons, and orthopedic surgeons are over the age of 55 [51]. Estimating the likelihood of retirement is difficult, given that physician self-report of retirement plans may not be entirely predictive of actual behavior [52]. Also, there is evidence that practice environment and work satisfaction can impact plans for retirement vs. continued practice [53].

General Surgery: A Case in Point

The American Board of Surgery (ABS) has certified diplomates in general surgery since 1938, and over the last 70 years, the field has changed dramatically. In the year 1938, 102 surgeons were board-certified, and in 2005 this number had increased to 1,026. Over the last 25 years, however, the number of general surgeons certified per year has been remarkably constant. Based on data obtained through the ABS regarding historical rates of certification, we have developed a basic model to estimate the number of general surgeons in practice. This model is based on the following assumptions (1) 1,000 annual certifications after 2005, (2) 30-year career in active clinical practice, and (3) 0.5% annual attrition rate. Based on this model, between 2005 and 2025 the number of active general surgery diplomates will increase by 2.1% (Fig. 12.11a). The numbers of active diplomates relative to the US population are shown in Fig. 12.11b.

The ratio of active general surgeons to the US population was highest in 1988, and declined by 7–8% by 2006. Based on our model, in 2025 the general surgical workforce relative to population-based demand will have decreased by 26% relative to 1988. Importantly, this figure is refractory to immediate changes in rates of surgical training. If in 2010, the number of diplomates per year is increased to 1,100 per year, the ratio of workforce to population-based demand will be only 5% higher in 2025 than if the rates of graduation remain at 1,000 per year.

These estimates and projections are limited in that all board-certified general surgeons are considered "general surgeons," regardless of sub-specialization in training/practice. A recent study based on data from the American Medical Association's Physician Masterfile estimated that between 1981 and 2005 the number of active general surgeons decreased precipitously from 7.68 to 5.69 per 100,000 [25]. This estimate only included surgeons who listed their primary area of specialty as general surgery, abdominal surgery, trauma surgery, or critical care. Over the last two decades, the proportion of graduating general surgical residents who pursue additional subspecialty training has grown, and is currently over 70% [54]. The amount of general surgery performed by diplomates with subspecialty training is largely unknown and difficult to measure.

Health Care Reform: Will It Solve the Problem?

There is no argument that US residents pay a greater amount for health care than any other country in the world. According to recent statistics, the annual per capita expenditure was $6,401, and between 1970 and 2005 the rate of increase in the proportion of GDP directed toward health care spending was faster in the US than in any other country [55]. In return for its investment, it does not seem that the US population receives a concomitantly higher quality of care [56]. Waste is considered rampant:

> As much as $700 billion dollars a year in health care services are delivered in the US that do not improve health outcomes.
>
> Peter Orszag, Director of Congressional Budget Office [57].

The $700 billion figure listed above represents approximately 5% of the GDP. It has been further estimated that reducing the administrative overhead costs associated with healthcare expenditures would save an estimated $400 billion (2003 dollars) per year [58].

Given these dramatic figures, it seems reasonable to consider ways in which the US health care system might reduce waste and improve the value returned on spent health care dollars. In this section, we will focus on three key areas (access to care, regional variation, and technological change) that are targeted by policy makers in their quest to improve the value and effectiveness of health care, and consider the impact of changes in these areas on the supply and demand for surgical services.

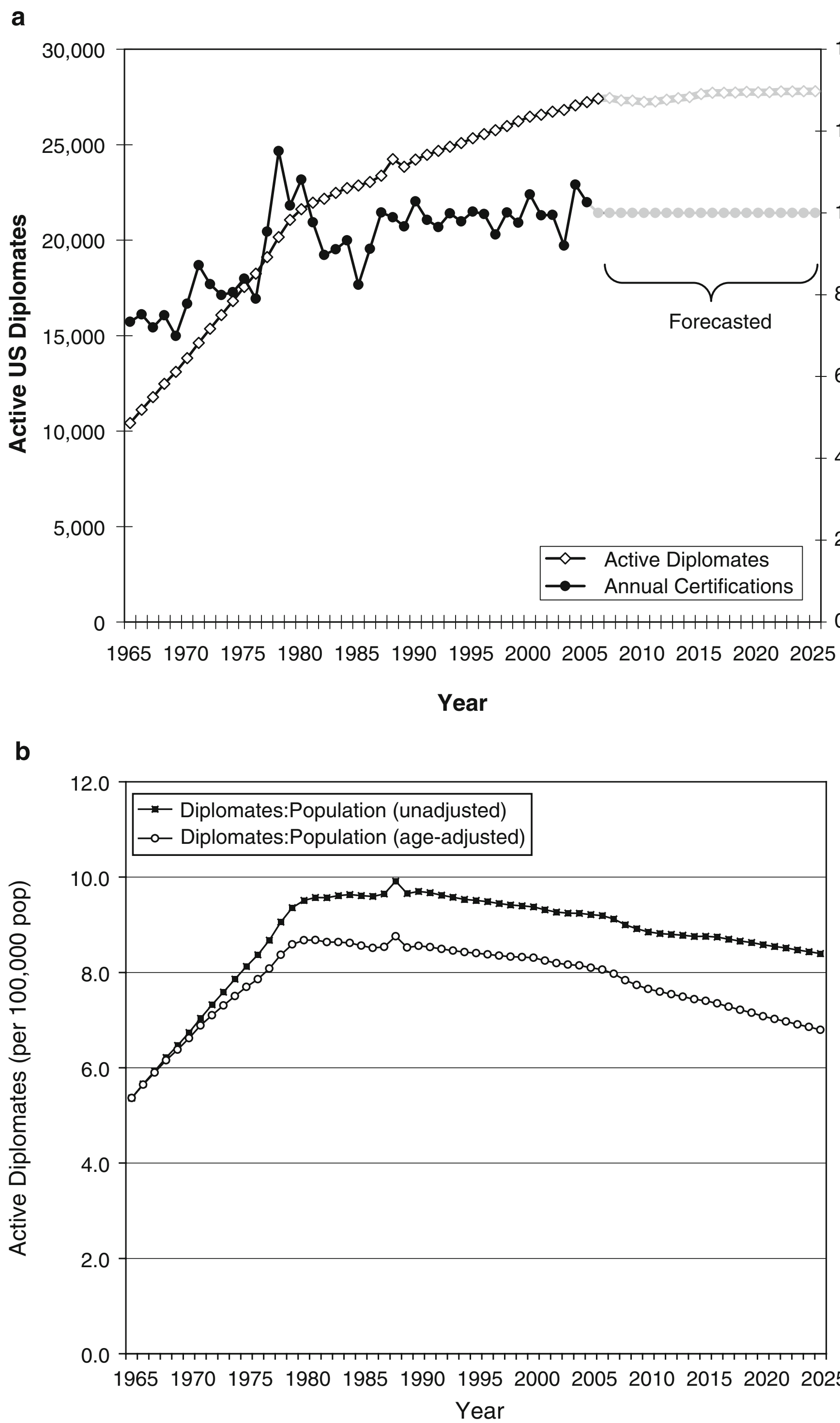


Figure 12.11 (**a**) ABS certifications: 1965–2025; (**b**) active general surgeons in US: 1965–2025.

Access to Care

Changes in the type of health insurance held by the US population have the potential to dramatically alter the way in which individuals access surgeons and surgical treatment. Two main ways in which this might occur is (1) through increased use of managed care models for health care delivery or (2) through universal (or expanded) health coverage.

The managed care boom of the 1990s led to a growing belief that these new systems would regulate the inefficient and fee-driven use of specialist care. In one controversial prognostication, Weiner et al. in a 1994 *JAMA* article anticipated that the increased use of managed care (to 40–65% penetration) would lead to a 60% surplus of "specialists" in the year 2000 [59]. As with some of the prediction models discussed earlier, these forecasts were based on assumptions that proved erroneous.

In a similar vein, universal health coverage (or simply improved access to health care) has the capacity to nearly instantaneously improve the ability of millions of US residents to access surgical care. What would be the effect of these changes on population-based demand for surgical procedures? In an AAMC report published in 2008, the impact of universal health coverage on the number of full-time physicians was modeled [60]. Their model found a 3.6% estimated increase in the physician workforce. This relatively small effect stems from the fact that the uninsured population is relatively young and healthy. It should also be noted that a significant amount of surgical care for nonelective conditions is already provided to this population through safety-net institutions. Expanded health care coverage may, however, result in increased demand for elective procedures, especially those performed in younger, healthier patients.

The impact of a burgeoning elderly population on Medicare – the primary payor for healthcare delivery for individuals over the age of 65 years in the US – also needs to be considered. In the 2008 annual report, the Social Security and Medicare Boards of Trustees painted a grim picture of the financial health of both of these entitlement programs. Beginning in 2008, the Medicare Hospital Insurance Trust Fund will pay out more in hospital benefits than it receives in taxes and revenues. As more and more baby boomers enter retirement age, this trend will accelerate, and the Medicare reserves may be exhausted before 2020. In 2008 there were an estimated 3.3 workers per retiree; by 2020 this ratio is projected to decrease to 2.1 by 2031 [61]. Several approaches have been proposed to help cope with the emerging problem of funding healthcare for a growing population of retirees. One mechanism that generated initial enthusiasm was the Medicare advantage plans, whereby Medicare beneficiaries could enroll in private health insurance plans [62]. The privatization of portions of the care provided through the Medicare benefit has thus far failed to produce significant cost savings. Innovative practice plans and chronic disease management models have shown some promise, but not yet sizable enough to make an impact on forecasted deficits. New types of payment models, including the prospective payment system have some benefits, but have resulted in the shifting of in-hospital care to pre- and post-hospital environments. Other proposals, such as the Breaux–Thomas proposed legislation to increase the eligibility of age to 67 or increase co-payments/deductibles have proven politically difficult [63]. It is safe to say that the costs associated with providing healthcare to the aging US population will be an issue of growing importance for politicians, payors, and providers.

Regional Variation in Procedure Utilization

The rate at which physicians provide services to the population varies widely from region to region. This concept of regional variation was originally described by Wennberg and colleagues at Dartmouth, and continues to be a core concern of health policy makers at all levels [64, 65]. The annual Dartmouth Atlas of Health Care uses Medicare data to describe variation in care, and spur health care reform efforts.

Figure 12.12 shows an analysis of publicly available data from the 2005 Dartmouth Atlas, which reports regional utilization using hospital referral regions (HRR) as the geographic unit of interest. Within the Atlas, each patient is assigned to one of 306 HRRs. The boundaries that encompass each HRR are derived based on documenting the referral patterns of

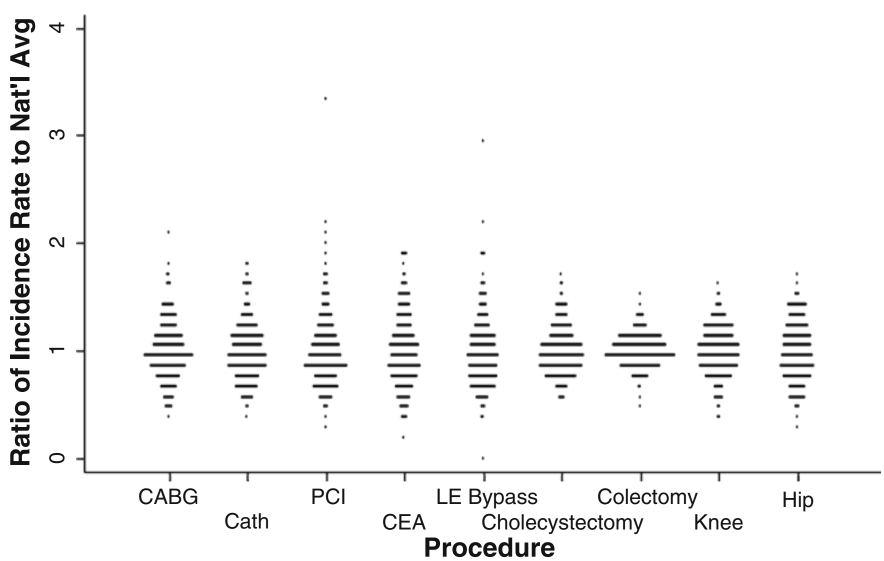


Figure 12.12 Regional (HRR) variation by procedure. Data from the Dartmouth Atlas of Health Care 2005.

patients who are referred for major cardiovascular procedures and for neurosurgery. In order to provide some data for a discussion regarding regional variation in procedure use, we will provide some preliminary data analysis.

Broadly speaking, these variations can only be the result of regional differences in either (1) the rates of disease or (2) the patterns of care received, and the extent to which each of these two explanations is responsible for the observed variations is difficult to assess. Why are there differences in the amount of variation between procedures? An elegant answer has been proffered by Birkmeyer et al., who note that procedures where the diagnosis does not linearly lead to a procedure (e.g., peripheral arterial disease ⇒ lower extremity bypass) may have greater variation than one where a procedure is the only logical next step (e.g., non-metastatic colon cancer ⇒ colectomy) [66].

For many, these variations are the manifestation of physician-induced demand, with subspecialists driving higher rates of potentially unnecessary procedures [67]. The extent to which this phenomenon exists has been hotly debated for decades. Another way of conceptualizing the debate over physician-induced demand is to consider part of the regional variations in rates of care as resulting from differences in the relative rates of underuse and/or overuse of surgical treatment. In moving forward with this concept, some definitions are important:

> Overuse: Occurs when a health care service is provided under circumstances in which its potential for harm exceeds the possible benefit
>
> Underuse: Failure to provide a health care service when it would have produced a favorable outcome for a patient
>
> Chassin and Galvin [68]

In determining the potential for a surgical procedure to provide an acceptable ratio of likelihood of benefit to possibility of harm – one estimate of value – the best available resources are evidence-based guidelines developed by professional organizations and consensus panels. The extent to which these guidelines reflect a significant body of evidence is not always perfect, but they are at least a starting point [69].

Generally speaking, it is much easier to accurately assess the presence of overuse than it is to quantify underuse. This is simply due to the availability of the denominator population. In a recent study by Keyhani et al., the appropriateness of tympanostomy tubes for otitis media in five New York hospitals was examined [70]. Of 682 pediatric patients who underwent the procedure, a majority (70%) were considered inappropriate overuse based on existing guidelines. In this study, the denominator population was easily identified – patients undergoing tympanostomy placement. A study examining underuse of tympanostomy tubes would be much more challenging, as it would involve examining primary care physicians' records for all patients with confirmed or suspected otitis media in a large population. If one was to examine the population-based need for tympanostomy tubes within New York, what would the actual use of the procedure be if there was no (or minimal) underuse or overuse?

Studies examining underuse yield dramatic findings as well. One classic study examined rates of coronary angiography after acute myocardial infarction (MI) within the Veterans Affairs (VA) system and Medicare [71]. The study cohort (denominator population) was defined a needed angiography based on American College of Cardiology guidelines. Cohort patients within the VA system received a needed angiography 43% of the time, whereas those in Medicare 51%.

Why are these types of studies important? As the demand for value in health care delivery increases, so will the expectation that procedure-based specialties justify the work they perform, in terms of outcomes for their patient population.

Technological Advance

The possibility that advancing medical technology will obviate the need for surgical care (and surgeons) is a source of great intuitive appeal and worthy of mention. Rates of surgical treatment for specific disease processes have been dramatically reduced, some nearly eliminated by innovation in medical (non-surgical) treatment. Some examples include peptic ulcer disease, tuberculosis, and coronary artery disease. The war on cancer also appears to be having some significant recent successes in reducing the incidence of certain malignancies, most notably lung, colorectal, breast, and prostate cancer [72].

On the other hand, minimally invasive surgical technology has resulted in a lower clinical threshold to perform specific surgical procedures (e.g., cholecystectomy) [73, 74]. With the increasing use of laparoscopic and other minimally invasive surgical approaches, more latent demand for procedures may be unlocked. Some surgical disease processes are actually becoming much more common (e.g., diverticulitis) [75]. And, surgical treatment is being applied to conditions that may have been historically managed only medically, for example obesity, with an estimated 113,000 inpatient surgical procedures for obesity per year in 2005 (800% increase from 1998) [76].

What is the overall impact of evolving technology on the profile and quantity of surgical procedures? In one study based on California data from 1990 to 2000, Liu et al. quantified trends in the volumes of 32 inpatient surgical procedures [77]. Total procedural volume increased by 20.4%, during a period in which the State population increased by 13.8%. Technological advance has the capacity to increase, decrease, and change the demand for surgical treatment.

Summary: Looking Toward the Future

The task of predicting what health care delivery will look like in the near (or distant) future is potentially foolhardy. In this chapter, we have demonstrated some of the most important variables that need to be considered in estimating the ability of the current and future systems of care to provide treatment to the US population. Despite the obvious difficulty in making accurate predictions and the historical problems with them, there is a growing consensus that the aging of the US population represents a looming crisis. Whatever magnitude of crisis evolves, efforts to minimize its impact on patient care will require action on multiple fronts and at multiple levels.

First and foremost, there is strong evidence that in the future demand for surgical procedures will outstrip the supply of surgeons. Solutions to this emerging problem will need to occur on multiple fronts. Training more surgeons is the most apparent solution, but this can only be part of the answer to the problem. In the immediate and near-term future (10–15 years) growth in surgical training programs can provide only a minimal boost to the active surgical workforce. Other informal pathways, such as allowing trained surgeons from other countries to become licensed in the US after an abbreviated domestic training may have some appeal, but the idea of draining these resources from less developed countries is ethically untoward [27, 78, 79]. In addition to increasing the number of new surgical trainees, attention may need to be focused on retaining those in practice. While the current state of the economy (and most retirement investment portfolios) may cause this even without any policy planning, steps may be taken to encourage physicians to remain in practice. This may call for developing means for surgeons in or near retirement to maintain reduced workloads with only proportionate reductions in professional income. Also, vanishingly little research has been conducted examining the relative efficiency of surgeons employed in private practice vs. academic practice vs. health maintenance organizations. The use of non-physician clinicians may have an important and widening role in enabling surgeons to focus more completely on operative and associated responsibilities and a reduced role in administrative and non-essential clinical activities.

The aging population will result not only in an increased demand for surgical procedures, but also in a different profile of surgical patients. Operations for disease processes specific to older patients will become more frequent, especially orthopedic and spinal operations. Patients will be older and more comorbid, and will require an increased focus on optimizing medical management. A greater partnership with medical hospitalists is already occurring, and will almost certainly continue to grow. In order to care for these patients in a way that provides the greatest benefit to the population at hand, surgeons need to be proactive in analyzing the outcomes, effectiveness and appropriateness of the surgical treatment provided to elderly patients. Rigorous quality monitoring and improvement efforts are a key part of how our field can rise to meet these demands.

In considering the impact of these forthcoming changes, surgeons of all specialties need to have a seat at the leadership table. The perspective of prominent health care economists envisions the physician workforce *en masse*, and in doing so may completely ignore crises within a particular field. Surgeons of all types will need to ensure that their needs and the needs of their patients are heard.

References

1. Dennison C, Pokras R (2000) Design and operation of the National Hospital Discharge Survey: 1988 redesign. Vital Health Stat 1 39:1–42
2. http://quickfacts.census.gov/qfd/states/00000.html. Accessed 20 Dec 2008
3. http://www.cms.hhs.gov-MedicareFeeforSvcPartsAB-Downloads-DRGDesc05.pdf. Accessed 20 Dec 2008
4. Reported figures based on original analysis of data from the 2005 Florida State Ambulatory Surgery Database
5. Reported figures based on original analysis of data from the 2006 National Hospital Discharge Survey
6. Kuo YF, Sharma G, Freeman JL, Goodwin JS (2009) Growth in the care of older patients by hospitalists in the United States. N Engl J Med 360(11):1102–1112
7. Ballarin R, Spaggiari M, Di Benedetto F et al (2009) Do not deny pancreatic resection to elderly patients. J Gastrointest Surg 13(2):341–348
8. Menon KV, Al-Mukhtar A, Aldouri A et al (2006) Outcomes after major hepatectomy in elderly patients. J Am Coll Surg 203(5):677–683
9. Shimada H, Shiratori T, Okazumi S et al (2007) Surgical outcome of elderly patients 75 years of age and older with thoracic esophageal carcinoma. World J Surg 31(4):773–779
10. Etzioni DA, Liu JH, O'Connell JB et al (2003) Elderly patients in surgical workloads: a population-based analysis. Am Surg 69(11):961–965
11. Chang GJ, Skibber JM, Feig BW, Rodriguez-Bigas M (2007) Are we undertreating rectal cancer in the elderly? An epidemiologic study. Ann Surg 246(2):215–221
12. Schrag D, Cramer LD, Bach PB, Begg CB (2001) Age and adjuvant chemotherapy use after surgery for stage III colon cancer. J Natl Cancer Inst 93(11):850–857
13. Schrag D, Gelfand SE, Bach PB et al (2001) Who gets adjuvant treatment for stage II and III rectal cancer? Insight from surveillance, epidemiology, and end results – Medicare. J Clin Oncol 19(17):3712–3718
14. Siu LL (2007) Clinical trials in the elderly – a concept comes of age. N Engl J Med 356(15):1575–1576
15. Baicker K, Chandra A (2004) Medicare spending, the physician workforce, and beneficiaries' quality of care. Health Aff (Millwood) Suppl Web Exclusives:W184–W197
16. Cooper RA (2009) States with more health care spending have better-quality health care: lessons about Medicare. Health Aff 28:w103–w115
17. Cooper RA (2009) States with more physicians have better-quality health care. Health Aff 28:w91–w102
18. American College of Emergency Physicians (2006) On-call specialist coverage in U.S. Emergency Departments: ACEP survey

of emergency department directors. American College of Emergency Physicians (Emergency Medicine Foundation). http://www3.acep.org/WorkArea/showcontent.aspx?id=33266. Accessed Apr 2006
19. Menchine MD, Baraff LJ (2008) On-call specialists and higher level of care transfers in California emergency departments. Acad Emerg Med 15(4):329–336
20. Mohanty SA, Washington DL, Lambe S et al (2006) Predictors of on-call specialist response times in California emergency departments. Acad Emerg Med 13(5):505–512
21. Shively EH, Shively SA (2005) Threats to rural surgery. Am J Surg 190(2):200–205
22. Fuhrmans V (2009) Surgeon shortage pushes hospitals to hire temps. Wall St J:A1
23. Brown D (2009) Shortage of general surgeons endangers rural Americans. Washington Post:A1
24. Fischer JE (2007) The impending disappearance of the general surgeon. JAMA 298(18):2191–2193
25. Lynge DC, Larson EH, Thompson MJ et al (2008) A longitudinal analysis of the general surgery workforce in the United States, 1981–2005. Arch Surg 143(4):345–350, discussion 351
26. Doty B, Zuckerman R, Finlayson S et al (2008) General surgery at rural hospitals: a national survey of rural hospital administrators. Surgery 143(5):599–606
27. Cofer JB, Burns RP (2008) The developing crisis in the national general surgery workforce. J Am Coll Surg 206(5):790–795, discussion 795–797
28. Finlayson SR (2005) Surgery in rural America. Surg Innov 12(4):299–305
29. http://www.aha.org/aha/resource-center/Statistics-and-Studies/fast-facts.html. Accessed 20 Jan 2009
30. DeLia D (2006) Annual bed statistics give a misleading picture of hospital surge capacity. Ann Emerg Med 48(4):384–388
31. Jeffers JR, Bognanno MF, Bartlett JC (1971) On the demand versus need for medical services and the concept of "shortage". Am J Public Health 61(1):46–63
32. McNutt DR (1981) GMENAC: its manpower forecasting framework. Am J Public Health 71(1081279592):1116–1124
33. Etzioni DA, Liu JH, Maggard MA, Ko CY (2003) The aging population and its impact on the surgery workforce. Ann Surg 238(2): 170–177
34. Cooper RA, Getzen TE, McKee HJ, Laud P (2002) Economic and demographic trends signal an impending physician shortage. Health Aff (Millwood) 21(121896737):140–154
35. Reinhardt UE (2003) Does the aging of the population really drive the demand for health care? Health Aff (Millwood) 22(6):27–39
36. Strunk BC, Ginsburg PB, Banker MI (2006) The effect of population aging on future hospital demand. Health Aff (Millwood) 25(3):w141–w149
37. Poisal JA, Truffer C, Smith S et al (2007) Health spending projections through 2016: modest changes obscure part D's impact. Health Aff (Millwood) 26(2):w242–w253
38. Catlin A, Cowan C, Heffler S, Washington B (2007) National health spending in 2005: the slowdown continues. Health Aff (Millwood) 26(1):142–153
39. Smith C, Cowan C, Heffler S, Catlin A (2006) National health spending in 2004: recent slowdown led by prescription drug spending. Health Aff (Millwood) 25(1):186–196
40. Dill MJ, Salsberg E (2008) The complexities of physician supply and demand: projections through 2025. AAMC, Washington, DC
41. Salsberg E, Rockey PH, Rivers KL et al (2008) US residency training before and after the 1997 Balanced Budget Act. JAMA 300(10):1174–1180
42. American Association of Medical Colleges Statement on the Physician Workforce (2006). http://www.aamc.org/workforce/workforceposition.pdf. Accessed 26 Aug 2008
43. AAMC (2008) Medical school enrollment plans: analysis of the 2007 AAMC survey. AAMC, Washington, DC
44. Dunn MR, Miller RS, Richter TH (1998) Graduate medical education, 1997–1998. JAMA 280(9):809–812, 836–845
45. Council on Graduate Medical Education (1994) Fourth report: recommendation to improve access to health care through physician workforce reform. U.S. Health Resources and Services Administration, Rockville, MD
46. Pew Health Professions Commission (1995) Critical challenges: revitalizing the health professions for the twenty-first century. The Third Report of the Pew Health Professions Commission. U.C.S.F. Center for the Health Professions, San Francisco
47. Institute of Medicine (2008) Resident duty hours: enhancing sleep, supervision, and safety. Institute of Medicine, Washington, DC
48. Dorsey ER, Jarjoura D, Rutecki GW (2005) The influence of controllable lifestyle and sex on the specialty choices of graduating U.S. medical students, 1996–2003. Acad Med 80(9):791–796
49. Hyman NH (2009) Attending work hour restrictions: is it time? Arch Surg 144(1):7–8
50. Liebhaber A, Grossman JM (2007) Physicians moving to mid-sized, single-specialty practices. Tracking Report, Center for Studying Health System Change, Washington, DC
51. Colleges Center for Workforce Studies (2006) Physician specialty data: a chart book. Center for Workforce Studies, American Association of Medical Colleges, Washington, DC
52. Rittenhouse DR, Mertz E, Keane D, Grumbach K (2004) No exit: an evaluation of measures of physician attrition. Health Serv Res 39(5):1571–1588
53. Kletke PR, Polsky D, Wozniak GD, Escarce JJ (2000) The effect of HMO penetration on physician retirement. Health Serv Res 35(5 Pt 3):17–31
54. Stitzenberg KB, Sheldon GF (2005) Progressive specialization within general surgery: adding to the complexity of workforce planning. J Am Coll Surg 201(6):925–932
55. Anderson GF, Frogner BK (2008) Health spending in OECD countries: obtaining value per dollar. Health Aff (Millwood) 27(6):1718–1727
56. Hussey PS, Anderson GF, Osborn R et al (2004) How does the quality of care compare in five countries? Health Aff (Millwood) 23(3):89–99
57. Address delivered to the annual meeting of the Retirement Research Consortium, 7 August 2008.
58. Himmelstein DU, Woolhandler S, Wolfe SM (2004) Administrative waste in the U.S. health care system in 2003: the cost to the nation, the states, and the District of Columbia, with state-specific estimates of potential savings. Int J Health Serv 34(1):79–86
59. Weiner JP (1994) Forecasting the effects of health reform on US physician workforce requirement. Evidence from HMO staffing patterns. JAMA 272(3):222–230
60. AAMC (2008) The complexities of physician supply and demand: projections through 2025. AAMC, Washington, DC
61. http://www.socialsecurity.gov/policy/docs/chartbooks/fast_facts/2003/fast_facts03.html#chart36. Accessed 30 Mar 2009
62. Berenson R, Hash M, Ault T et al (2008) Cost containment in medicare: a review of what works and what doesn't. AARP Policy Institute, Washington, DC
63. http://thomas.loc.gov/medicare/. Accessed 30 Mar 2009
64. Wennberg J, Gittelsohn A (1973) Small area variations in health care delivery. Science 182(117):1102–1108
65. Wennberg J, Gittelsohn A (1982) Variations in medical care among small areas. Sci Am 246(482199381):120–134
66. Birkmeyer JD, Sharp SM, Finlayson SR et al (1998) Variation profiles of common surgical procedures. Surgery 124(599040741): 917–923
67. Grumbach K (2002) The ramifications of specialty-dominated medicine. Health Aff (Millwood) 21(1):155–157
68. Chassin MR, Galvin RW (1998) The urgent need to improve health care quality. Institute of Medicine National Roundtable on Health Care Quality. JAMA 280(11):1000–1005

69. Sanghavi D (2008) Plenty of guidelines, but where's the evidence? New York Times, 9 December 2008
70. Keyhani S, Kleinman LC, Rothschild M et al (2008) Overuse of tympanostomy tubes in New York metropolitan area: evidence from five hospital cohort. BMJ 337:a1607
71. Petersen LA, Normand SL, Leape LL, McNeil BJ (2003) Regionalization and the underuse of angiography in the Veterans Affairs Health Care System as compared with a fee-for-service system. N Engl J Med 348(2222658539):2209–2217
72. Jemal A, Thun MJ, Ries LA et al (2008) Annual report to the nation on the status of cancer, 1975–2005, featuring trends in lung cancer, tobacco use, and tobacco control. J Natl Cancer Inst 100(23):1672–1694
73. Chen AY, Daley J, Pappas TN et al (1998) Growing use of laparoscopic cholecystectomy in the national Veterans Affairs Surgical Risk Study: effects on volume, patient selection, and selected outcomes. Ann Surg 227(198105850):12–24
74. Escarce JJ, Chen W, Schwartz JS (1995) Falling cholecystectomy thresholds since the introduction of laparoscopic cholecystectomy. JAMA 273(2095264520):1581–1585
75. Etzioni DA, Mack TM, Beart RW Jr, Kaiser AM (2009) Diverticulitis in the United States: 1998–2005: changing patterns of disease and treatment. Ann Surg 249(2):210–217
76. Maggard MA, Yermilov I, Li Z et al (2008) Pregnancy and fertility following bariatric surgery: a systematic review. JAMA 300(19):2286–2296
77. Liu JH, Etzioni DA, O'Connell JB et al (2003) Inpatient surgery in California: 1990–2000. Arch Surg 138(10):1106–1111, discussion 1111–1112
78. Hooper CR (2008) Adding insult to injury: the healthcare brain drain. J Med Ethics 34(9):684–687
79. Wright D, Flis N, Gupta M (2008) The 'Brain Drain' of physicians: historical antecedents to an ethical debate, c. 1960–79. Philos Ethics Humanit Med 3:24