

Special articles

Managed health care and academic anesthesiology in the United States

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Introduction

Since the mid-1980s, health-care systems in the United States have rapidly evolved from the traditional fee-for-service system to so-called managed care, driven by the principles of the market economy. This ongoing development has created severe financial difficulties for the country's hospitals, especially for university-affiliated teaching hospitals, where the quality of patient care is adversely affected and, indeed, the very existence of some major academic medical centers is threatened. The consequences of the health-care crisis have been felt particularly hard by anesthesiologists in academic institutions.

Why is health care in the United States, purportedly the richest country with virtually unlimited resources and technology, suddenly in such a dire financial crisis? The answer is rather complicated, and the situation is confusing, even for physicians practicing in the United States. The crisis in American health care may be even more puzzling for people in other industrialized countries, where universal coverage of basic medical care is available to all citizens. It is therefore worthwhile to first review the basic characteristics of American health-care systems, past and present, before assessing the health-care system that prevails today, managed care, and the devastating effects it has had on American health care and academic medicine.

Changes in health-care finances

Over most of the past half century, the United States has enjoyed a strong economy with the highest gross domestic product in the world and technology and health-care institutions at the cutting edge of advancement. Yet, unlike the situation in most industrialized nations, basic health-care insurance has not been guaranteed to all of its citizens. Until the early 1990s, most American workers enjoyed health-care coverage provided by nonprofit, public health insurance companies, such as Blue Cross (paying hospital costs) and Blue Shield (paying physician costs). Since 1965, governmental health-care agencies have taken care of elderly citizens with Medicare, an entitlement health insurance program for the elderly financed through federal payroll taxes, and with Medicaid, a state-run health-care program for the poor (mostly for families with children and the disabled). However, over the last several decades the costs of health care have risen at a rapid pace, far outpacing the rate of inflation. The escalating costs have been due in part to advances in medical technology (such as magnetic resonance imaging [MRI] and organ transplantation). Other reasons for the escalating medical costs include the extensive specialization of American medicine, with too many specialists performing expensive procedures, increasingly expensive drugs, and excessive malpractice lawsuits with substantially high punitive rewards. At the same time, health insurance premiums, keeping pace with increasing health-care costs, have increased markedly. The situation on the one hand leaves many small businesses unable or unwilling to provide insurance copayments for their workers and, on the other hand, leaves the employees of these businesses unable to pay for the insurance premiums themselves. The result is that over the last decade there has been an alarming increase in the number of residents without health-care insurance. The number in the new millennium is approaching 40 million, out of the

American population of approximately 280 million people [1].

In 1993, the Clinton administration attempted to create a sweeping national health insurance program similar to those available to the citizens of most industrialized nations (with those benefits and shortcomings). However, the so-called patients' bill of rights failed miserably in the United States Congress. It was viewed as being too radical for conservative constituents, who were weary of governmental controls over health care and unreceptive to the tax increases necessary to cover the costs.

The failure of the Clinton health plan signaled the approaching end of health care as Americans had for many years known it (i.e., fee-for-service care) and heralded the emergence of the era of managed care, a system in which reduced fees for medical services are continually negotiated and fundamental decisions on patient care are controlled not by physicians but by for-profit health maintenance organizations (HMOs) [2–4]. Managed-care plans grew rapidly in the 1990s, beginning in the Pacific coast region, and spread like a forest fire throughout the rest of the nation. The results were drastic decreases in the fee-for-service income of physicians and a progression toward a so-called capitated environment in which, in order to cut the operating costs of the health-care industry, physicians are penalized for doing more procedures (and rewarded for doing less) while the executives in control of HMOs have enjoyed multimillion-dollar bonuses. To reduce health-care costs, most relatively minor surgical procedures were shifted to a same-day basis, with many additional patients admitted to the hospital on the day of major surgery (even including open-heart surgery), thus dramatically decreasing hospital bed occupancy as well as reimbursement revenue [3]. For example, under managed care, obstetrical patients were covered for only an overnight stay after the delivery (however, the outcry from consumers on this issue was great and the news media coverage was wide, which led to a policy shift that allowed a hospital stay of up to two nights).

In an attempt to stem the tide of skyrocketing health-care costs, governmental policy makers tried to correct the future course of American health care by increasing the role of primary care physicians (PCPs), who would act as “gatekeepers” to limit the number of patients seen by specialists [3]. (For example, patients with heart disease would be treated by general practitioners, who would charge less than cardiologists.) The Accreditation Council for Graduate Medical Education recommended a limit on the total number of residents to 110% of the United States medical school graduates and cut specialist training to 50% of all positions [4]. Consequently, and in line with the overall strategic aims, medical school administrators were pressured into en-

couraging more graduating medical students to pursue primary care fields, such as internal medicine, pediatrics, and family medicine, and discouraging them from going on to specialty training.

To achieve the major dual goals of advancing the frontiers of medical care and achieving postgraduate medical education, the cost of health care at major academic centers, understandably, has been higher (by an estimated 20%) than at nonteaching hospitals [4,5]. In addition, major teaching hospitals accept and treat larger proportions of patients with multiple health problems and without health insurance coverage than do nonteaching community hospitals. To be fiscally solvent, academic medical centers have utilized multiple financial resources to compensate for the deficits created by this uncompensated health care. These resources include income from university physicians' practice plans; government grants and contracts; federal, state, and local government appropriations; and a premium of approximately 20% for services paid by private insurers [4]. In addition, from 1965 to the mid-1980s, Medicare provided reimbursements to teaching hospitals for a portion of the added expenses incurred by postgraduate residency training programs (Medicare Direct Graduate Medical Education [DGME] payment), which, in addition to residents' stipends, included partial payments of salaries and fringe benefits for supervising physicians [4]. This reimbursement was unlimited in terms of the number of residents covered and allowed academic medical centers to increase the size of residency programs as needed [4]. This need-based reimbursement, however, was terminated in 1986, when the United States Congress passed the Consolidated Omnibus Budget Reconciliation Act that restricted DGME payments to teaching hospitals [4]. Medicare also limited the duration of reimbursements, based on the length of residency and fellowship training in various clinical specialties [4]. Currently, the number of residents is essentially limited to that in 1996, regardless of increases in their clinical services [4,6].

In 1998, the United States Congress passed the Balanced Budget Amendment (BBA), which further reduced reimbursements to teaching hospitals for graduate education, resulting in progressive financial difficulties for academic medical centers [3,4,7]. According to data from the Association of American Medical Colleges, the total profit margin for major teaching hospitals decreased from approximately 3% in 1996 to less than 1% in 2001 (with most academic centers in negative balance). In comparison, the profit margin for nonteaching community hospitals decreased from approximately 6% in 1996 to 4% in 2001 [4,7]. As a survival strategy, many major academic medical centers have acquired regional community hospitals as sources of patient flow to specialty teaching hospitals. A

number of academic medical centers have merged with regional academic rivals in the struggle for financial survival [4]. Some of these mergers have failed (such as that between the University of California at San Francisco and Stanford University), generating major financial losses. Others have been even less fortunate, ending up in bankruptcy (e.g., Allegheny University/Hahnemann and the Medical College of Pennsylvania) [4]. It is important to note that the dire financial constraints put upon academic medical centers occurred during the decade in which the United States economy experienced unprecedented growth and generated a huge federal budgetary surplus [3].

The costs of Medicare, which cover health care for elderly citizens, have continued to rise over the years, despite the government's efforts at cost containment. Over the last 5 years, total Medicare spending has increased by 24% to \$238 billion in 2001, and it is expected to grow faster in the next 5 years, to \$310 billion in 2006 [8]. The *New York Times* recently reported that Medicare payments to physicians were cut by 5.4% for the year 2002 [8]. The United States government foresees that the fees paid will be further reduced over the next 3 years for a total reduction of 17% by 2005 [8]. The impact of these cuts will be greatly compounded by the fact that many private insurers link their payments to changes in Medicare payments (although the private insurer's payments may be higher than those provided by Medicare) [8]. The health policy experts predict that the cuts could make it more difficult for the elderly to find doctors and hospitals willing to accept patients on Medicare, just as the need for health care continues to increase with the aging of the population [8]. Currently, Medicare covers approximately 40 million people. The number is expected to double by the year 2030 [8]. Significant numbers of physicians for the first time are refusing to take new Medicare patients because the government now pays too little to cover the costs of taking care of the elderly [8]. Some of these patients eventually receive emergency medical care at one of the financially beleaguered academic medical centers, further impacting their fiscal crisis.

Growth and development of anesthesiology as a specialty in the United States

In the 1970s and 1980s, the relatively new specialty of anesthesiology grew at a rapid pace, as increased and more complex surgical procedures created a demand for highly trained physician anesthesiologists, rather than certified registered nurse anesthetists (CRNAs), who outnumbered the trained physician anesthesiologists until the mid-1980s [9]. In the 1980s, the number of anesthesiology residents increased significantly with the

recognition and prestige of the new specialty, and because anesthesiology then had only a 2-year residency program and its graduates were in high demand [9]. Furthermore, medical students were attracted by the (apparent) lifestyle of anesthesiologists, with relative freedom of time when they were off duty [4,9]. Teaching hospitals were pleased with anesthesiology departments that could manage the hospital's clinical load using anesthesia residents, rather than using the more costly alternative of anesthesia providers (i.e., CRNAs) [9]. The educational reimbursement from Medicare was an additional incentive for recruiting more residents: the cost of a resident was less than that of a CRNA and, additionally, the governmental reimbursement to the hospital for each resident at that time was significantly more than the cost of the resident for the hospital [9,10]. From 1970 to 1990, the number of practicing anesthesiologists tripled, from about 10 000 to 30 000, and by 1987 it surpassed the number of CRNAs [9]. By the mid-1990s, the total number of M.D. anesthesiologists and CRNAs combined, who collectively provided anesthetics in the United States (estimated to be over 30 million cases annually), had reached 60 000 [4,7]. The number of anesthesiology faculty members in academic medical centers also rose, from 1500 in the mid-1970s to 4000 in the mid-1990s [4].

How has anesthesiology practice been affected by managed care?

With the rapid increase in the anesthesia work force in the 1980s, and with the inevitable dominance of managed care over the horizon, there was increased concern about an oversupply of anesthesiologists [4]. In 1994, the American Society of Anesthesiologists (ASA) commissioned a consulting firm to analyze the anesthesiology health-care market and to predict the future manpower needs for anesthesiology [4]. The report, based on several assumptions (most of which turned out to be inaccurate), included predictions of a high (90%) rate of operating room utilization, no growth in surgical procedures, and an extensive utilization of nonphysician anesthesia providers, especially CRNAs. The report predicted an oversupply of anesthesiologists for the foreseeable future. This concern was highlighted in the nonmedical press, such as the *Wall Street Journal* [10].

Partly because of this untimely—and unfortunately inaccurate—ASA report on future manpower needs, the field of anesthesiology appeared to have been singled out as a specialty likely to have an oversupply of practitioners in the future. This was especially so, since anesthesiology would be impacted by the expected decreases in surgical procedures resulting from capitated

health care [3,4,11]. (This expected decrease, however, did not occur.) Most anesthesiologists in private practice in the mid-1990s, sensing the impending economic disaster with managed care, adopted a wait-and-see attitude and delayed or halted recruitment for filling vacancies created by natural turnover and attrition. Consequently, for the first time in the history of the anesthesiology training program, the graduating class of anesthesiology residents, even from the nation's most prestigious medical centers, could not find desirable employment positions anywhere in the United States [11]. Not surprisingly, there was a drastic reduction in medical student applicants to anesthesiology programs, occurring within the setting of a stable production of about 17000 American medical student graduates annually [4]. The graduating class of anesthesiology residents in 1994 was 1873, whereas the entering class of first-year clinical residents was only 745 [4,11,12]. Nearly all anesthesiology training programs across the nation suffered a substantial drop in the number of residents. Actually, the decrease in the number of resident applicants was even worse, because the proportion of graduating anesthesiology residents from American medical schools dropped from 87% in 1994 to 43% in 2000 [4,12,13]. During the same period, the number of accredited anesthesiology training programs also decreased substantially.

From the early 1980s to the early-to-mid 1990s, the number of anesthesiologists in active practice had been increasing steadily, at an annual rate of approximately 3.6% [9]. However, in the late 1990s the growth rate dropped precipitously, to 0.6% [4,13]. This sluggish growth rate in the late 1990s was reflected in the decreased rate of growth of membership of the ASA [13]. At the same time, and contrary to the earlier prediction by the ASA analysis, advances in surgical technology and increases in the aging population of the United States resulted in substantial increases in surgical procedures. These increases were and continue to be far out of proportion to the sluggish increases (or the lack thereof) in the numbers of active and practicing anesthesiologists [4,13].

Managed care and anesthesiology in academic medical centers

Clinical anesthetic management (hands-on anesthetic care) in academic anesthesiology program settings has been carried out by anesthesia residents alone in some institutions and by a mixture of residents and CRNAs in others, in both settings under the supervision of attending anesthesiologists. In the past, anesthesiologists in academic medical centers could enjoy their academic freedom and have time for teaching and research, al-

though their income was, in general, far below that of their colleagues in private practice. With the emergence of managed care, however—and the sudden cut by half of the number of residents—anesthesiologists in academic medical centers had to face the formidable dual tasks of providing necessary clinical services while running academic teaching and research programs [4]. Guaranteed time for academic creativity had suddenly evaporated. Academic anesthesiologists, often left administering anesthetics by themselves, found their clinical commitment increased to the level of the full-time private practitioner—or to an even more work-intensive level and a longer duration—but without the financial benefit [4]. These unanticipated and dramatic deteriorations in the working environment, together with the financial crisis of the anesthesiology departments and their parental academic medical centers, have placed tremendous mental and physical stresses on academic anesthesiologists [4]. A substantial fraction of academic anesthesiologists, especially relatively junior members, simply gave up and left for more lucrative private practice where the work is less. The retention and recruitment of junior faculty has become, and still represents, a major and difficult task for academic anesthesiology departments [4].

Toward the turn of the millennium, the overall job market for and income of anesthesiologists in the private practice sector improved markedly, as the shortage of available anesthesiologists continued to grow—the very shortage that had resulted from the decrease in anesthesiology trainees in the mid-to-late-1990s. However, the quality of academic life has continued to deteriorate as academic departments struggle to cope with decreasing professional fee reimbursement in teaching institutions that themselves are struggling for financial solvency [4].

Financing of academic hospitals and departments of anesthesiology in the United States

In the United States, each medical center and the clinical departments within them must be fiscally responsible and financially self-sustaining. The fee schedule for anesthesiology services differs from that of all other clinical services because of the inclusion of the time unit in its fee schedule [14]. The formula used by Medicare in computing the anesthesiologist's professional reimbursement is $(RVU + \text{time units}) \times \text{conversion factor}$, with RVU referring to the ASA relative value base units, times units meaning 15-min increments, and the Medicare conversion factor, which in the year 2001 was \$17.83 [6,15].

The relative value-base unit varies, depending on the complexity of anesthetic care involved and the patient's

state of health (i.e., ASA physical status). Medicare has managed to decrease anesthesia reimbursement over time. The conversion factor represents compensations for physicians' services (72%), business expenses (21%), and malpractice or liability insurance costs (7%) and is modified annually for inflation and additional factors [14]. In the mid-1990s, Medicare introduced new reimbursement guidelines, phased in over a 4-year period, for the concurrent supervision of residents and CRNAs by anesthesiologists. For a one-to-one supervision, the anesthesiologist receives the full (Medicare allowable) reimbursement; for a one-to-two supervision and upward, the reimbursement was cut to 50% per case [6].

In addition to professional charges from anesthesiologists, the hospitals also charge the patients and/or their insurers flat rates for the level of services provided (based on the complexity of procedures), for anesthesia time units, and for additional special procedures. The covered costs of providing anesthesia services include anesthesia equipment, drugs, and ancillary personnel, and until recently they included the salaries and fringe benefits of CRNAs. Under managed care, however, the financial responsibility for CRNAs has been shifted to the anesthesiology department in many academic medical centers.

For commercial or private American insurance companies, reimbursements vary substantially from payer to payer (and are normally much higher than the Medicare reimbursement rates), but the insurers utilize Medicare and Medicaid fee schedules as comparison tools for their own payment and reimbursement schedules. Some insurers make payments based upon a specific percentage of the set fee schedule or some proportion of the conversion factor of either or both Medicare and Medicaid fee schedules. Others negotiate their own reimbursement rates with the professional corporations representing the anesthesiologists. Of the total United States population in 2001, managed care comprised 15% of Medicare, 57% of Medicaid, and 88% of commercial insurers. As noted earlier, approximately 14% of the total United States population (about 40 million) are uninsured [16]. In general, revenues from insurers under managed care are estimated to be under 40% of the total revenues collected, with the remainder of the revenues attributable to non-managed-care private insurance payers. Less money getting collected through continually renegotiated managed-care contracts results in a continually diminishing funding of the academic mission. Because of these extremely low payments from managed-care HMOs, a number of academic medical centers and professional corporations have merged, in attempts to have stronger voices in negotiations with HMOs. Some of these academic organizations, in pursuit of

financial protection and viability, have created their own HMOs.

The revenues collected on behalf of anesthesiologists are used to cover a wide array of expenses. These expenses include departmental operations, professional salaries and benefits, malpractice insurance premiums, general professional expenses, billing office fees, corporate office expenses, and the overhead for postgraduate education and the Dean's office. Overhead encompasses the costs of operating each of the areas that indirectly or directly benefit the physicians in the academic departments. The Dean's office overhead encompasses funds spent to run the administration of the school of medicine, including the subsidies for the basic science departments. These costs get passed off to each of the clinical departments as a form of taxation, known as "the dean's tax" (it has varied from 5% to as high as 20% of departmental revenues among the various major academic institutions over the years). Given the operating costs, the physicians' practice typically collects enough revenue to operate at a near break-even point (albeit the effort is not always successful). Meanwhile, although the hospital revenue from anesthesia services (which is separate from physicians' fees) is substantial, this source of funds is often used to finance other hospital operations, instead of being reinvested in the anesthesiology department or its related activities, such as intensive care units and pain services.

Anesthesiology and medical education in the United States

Undergraduate medical education

Until the 1980s, the overall goal of medical school education was tilted toward the excellence of basic and clinical sciences and postgraduate specialty training. With the advent of managed care and with increased public awareness and demands for better health care, the emphasis on undergraduate medical education has shifted considerably. The focus has moved from medical science per se toward the fostering of improved clinical and "people" skills for better-quality patient care and the training of more primary care physicians. In the United States the third- and fourth-year medical students are well exposed to clinical medicine as "junior interns" working under the guidance of residents and attending physicians of most clinical departments. Historically, however, the involvement of anesthesiologists in medical student education has been limited [17]. A 1998 survey of 107 anesthesiology departments indicated that the involvement of anesthesiology departments in undergraduate medical education was still lagging behind that of other clinical disciplines [4]. In

this survey by the Society of Academic Anesthesiology Chairs, the average amount of time in the medical school curriculum allocated to anesthesiology was found to be almost none during the first 2 years of a 4-year medical school education [4]. Furthermore, the core medical student rotations in anesthesiology during the third and fourth year was on average only 3 days per year [4]. The average elective rotation in anesthesiology was 1.8 weeks during the third year and 3.4 weeks during the fourth year [4] (but not all graduating medical students took advantage of these opportunities). These bleak statistics did not help the recruitment of medical students to anesthesiology in the mid-1990s, when the deans of medical schools were actively discouraging their medical students from specializing—especially in anesthesiology.

In 1966, the American Society of Anesthesiologists, in an attempt to improve the awareness of anesthesiology among medical students, launched a preceptorship program in anesthesiology. The program offered (along with a modest stipend) an 8-week course in clinical anesthesia, usually during the summer, under the supervision of either an academic or a nonacademic anesthesiologist [4,18,19]. However, a later analysis of the program, based on responses of students from ten medical schools, indicated that the students' exposure to anesthesiology did not significantly improve their attitudes toward the specialty. Interestingly, however, their views on anesthesiology in general did improve toward the senior year, regardless of whether they had participated in the preceptorship [18,19].

It appears that the quality, rather than the quantity, of exposure to anesthesiology may make the difference in the medical students' perception of this specialty. For example, at the University of Pittsburgh Medical Center, the Department of Anesthesiology and Critical Care Medicine has been actively involved in the medical school curriculum. The department took initiatives to organize and run a core Clinical Procedure Course in the second-year curriculum. The course includes the certification by the American Heart Association of basic life support, airway maintenance, vascular access, and respiratory and hemodynamic monitoring, as a prerequisite to clinical rotation. During the junior (third) year, there is a 2-week core clerkship in anesthesiology, in which medical students spend all day in the operating room, where they have hands-on experience under one-on-one supervision by an attending anesthesiologist. In addition to daily reading assignments and discussion sessions, the medical students go through four supervised sessions of virtual resuscitation and the administration of anesthetics at the anesthesia simulation laboratory. In this institution, the anesthesia rotation is very popular among the medical students. The hands-on experience in anesthesiology is prized, and many of the

students return for an additional 4-week elective clerkship in anesthesiology during the senior (fourth) year. Consequently, a relatively large percentage of them (as many as 10% to 15% annually) choose anesthesiology and related fields as their future specialty.

Postgraduate education in anesthesiology

As noted previously, the most significant change in postgraduate education in anesthesiology (i.e., residency training) that occurred in the 1990s was the major reduction in the number of residents. This reduction was a direct result of the expansion of the managed-care system and the resultant panic among practicing anesthesiologists. However, there have been other major changes in anesthesiology postgraduate education, both conceptual and quantitative, that have developed independently of managed care. In the 1988–89 academic year, the American Board of Anesthesiology increased the duration of residency training required for board eligibility by an additional year, to a total of 4 years [20]. The added year of residency training can be spent on one of three tracks: “the advanced clinical track,” which emphasizes the management of complicated anesthetic cases of all types; “the clinical scientist track,” 6 months of which can be spent in anesthesia-related research; and a track of 9 to 12 months of “subspecialty training” or two 6-month experiences in two separate anesthesiology subspecialties [4,20].

This new system has some inherent problems. The 6 months of research, although well intended, is of insufficient duration for most residents to do meaningful investigation or to learn sufficient research skills [4]. In addition, the lengthening of anesthesiology residency has resulted in decreases in the number of residents staying for an additional (fifth postgraduate) year of subspecialty training [21]. In the old system before 1989, the fourth postgraduate year (which followed one year of internship and two clinical years of anesthesia) had been an elective year and was usually spent in clinical subspecialty fellowship training. However, the majority of fourth-year anesthesiology residents currently pursue the advanced clinical track without further subspecialization [4]. With this change in the duration of residency training in anesthesiology, the board imposed specific minimal quantitative requirements for anesthetic cases in various categories of anesthesia experience: for example, a total of 165 conduction anesthetics, including 50 cases each of spinal and epidural anesthetics; 115 pediatric cases, including 15 infants; and so on [21]. On the one hand, the new regulations could improve the quality of clinical training, as intended, by limiting the number of residents according to the availability of the variety of clinical

cases necessary to fulfill required clinical training. On the other hand, however, these regulations also limit the freedom of residents to get experience in various subspecialties. For instance, in many institutions the duration of regular clinical rotations of residents through pediatric anesthesia has been cut from three months to 2 months each, to be fulfilled during their second and third clinical year rotations. However, this is insufficient time for residents to achieve clinical competence in these areas.

The future of academic anesthesiology in the United States

The challenges that anesthesiology departments in academic medical centers must deal with in the 21st century are multiple and formidable and are all linked together: financial stability, the recruitment and retention of anesthesiology faculty, the recruitment of medical students into anesthesiology, the improvement of undergraduate medical education in anesthesiology, and, finally, research and the direction of research in the future.

The first and foremost challenge for academic medical centers, and for anesthesiology departments in particular, is the struggle to have sufficient financial resources to continue their principal missions of education, research, and optimal patient care while maintaining sufficient human resources to carry out these missions [4]. Until the early 1990s, these missions had been financed to a significant degree by clinical revenues. For example, during the academic year 1992–93, approximately 28% of the total revenue from academic faculty practice plans (\$8.3 billion) was utilized for academic programs. The allocations of these funds included research (\$816 million), undergraduate education (\$702 million), and postgraduate education (\$594 million) [4,21]. With the advent of managed care, these resources have quickly evaporated as hospital revenues have dwindled. This is the result of the fierce competition for health-care revenues among for-profit HMOs as well as governmental policies designed to curb health-care expenditures [23]. Academic institutions are left with insufficient funds to cover compensation for the faculty and ancillary hospital workers [21]. With the mergers of university hospitals with nonteaching community hospitals (essentially a necessary survival strategy in the new managed-care environment), traditional “academic medical centers” are evolving into “academic health systems” [23]. As Drs. Reves and Greene have aptly forewarned, academic medical centers “could find themselves in possession of large health systems devoid of any academic function simply because the money used to build the health system is

expended and none remains to defray the . . . cost of teaching and research” [23].

The second challenge for academic anesthesiology is the recruitment and retention of academic anesthesiologists. The levels of financial compensation for academic clinicians have been far below the average for their colleagues in private practice (this is especially true for junior members of relatively lower academic rank). Previously academic clinicians had been willing to sacrifice financial rewards in exchange for academic lifestyle, with the time to pursue the academic and intellectual activities of teaching and research. With the coming of managed care and its decreasing financial resources, and especially with the severe staff shortages in academic anesthesiology departments, nonclinical (or academic) time for faculty members has dwindled to the level found in private practice. Dwindled as well is the morale of junior faculty members, who are unable to pursue their academic missions as they had envisioned them. Their departure for private practice (where there are plenty of opportunities created by the shortage of anesthesiologists) puts further strains on the quality of academic life for the remaining faculty. The situation has been made even worse in some academic medical centers that have acquired community hospitals and their anesthesia practices. There are salary inequalities between the academic and nonacademic anesthesiologists within the same department. In a number of proactive academic anesthesiology departments, there have been considerable efforts to correct these inequalities, to improve faculty retention and to equalize compensations. The corrective actions in these proactive departments are based in part on the extent of the faculty’s clinical activities that are generating revenues along with incentive plans to reward teaching, research, and other academic and administrative productive activities.

The third challenge for academic anesthesiology departments is to improve both undergraduate medical teaching in anesthesiology and the recruitment of graduating medical students into the specialty of anesthesiology. As stated above, the exposure of medical students in the United States to anesthesiology in general has been insufficient, both qualitatively and quantitatively. Consequently, medical students’ concepts and understanding of anesthesiology have been limited [4]. Active participation by anesthesiology departments in the medical school curriculum is essential if innovative courses in anesthesiology are to be included as part of the core curriculum. Furthermore, in addition to being proactive in technical areas related to anesthesiology (such as the teaching of basic and advanced life support, respiratory and circulatory assessments, and airway management), academic anesthesiologists should take an active part in instruction on organ physiology, pharmacology, and related subjects. These subjects have

traditionally been taught in most medical schools by members of the basic science departments. In the era of molecular biology and genetics, however, the experience and knowledge of basic science teachers in organ physiology and human pharmacology may well be inferior to those of clinical scientists [21].

Fortunately, over the last 2 years there has been a sudden upsurge of well-qualified American medical graduates entering into anesthesiology residency programs. This renewed popularity of anesthesiology is due, in part, to the current great demand for practicing anesthesiologists, to a surplus of primary care physicians, and, encouragingly, to improved undergraduate education in anesthesiology. These medical school graduates view anesthesiology as a specialty in which "the physician is rendering care directly, free of . . . authorization by an HMO . . . to administer a specific drug." The graduates show a "growth in interest in pain management . . . [and] advances in scientific basis of the specialty" [24]. Anesthesiologists are viewed by medical students as those "more likely to offer to assist them with questions they have, to show them an interesting physiologic finding in the operating room, and to talk with them about their interests" [22]. Within a few years, these new graduating anesthesiologists will decrease the manpower shortage and hopefully strengthen the quality and quantity of academic anesthesiology.

Finally, for the specialty of anesthesiology to survive through the current fiscally challenging times and beyond, there needs to be a concerted effort to strengthen future research activities in anesthesiology and related fields in which anesthesiologists can and should take a leading role. Without these efforts, the future of academic anesthesiology will be bleak. In spite of the doubling in the number of board-certified anesthesiologists over the last 20 years, research productivity by anesthesiologists, as judged by the amount of research funding from the National Institutes of Health (NIH), has remained below 5% of total NIH funding since the early 1980s [4]. Anesthesiology has ranked between the 23rd and the 25th among various specialty categories (although actual figures are considerably higher, because funding for anesthesiologists under other specialty categories was not included) [4,25].

Anesthesiologists have been and should remain active in clinical research involving clinically important areas of organ physiology, particularly respiration and circulation. Although the most fundable research proposals since the 1990s have involved molecular biology and genetics, organ-based physiology is still vital for the clinical management of patients under general anesthesia and critical care. Clinical pharmacology involving anesthetics, sedatives, opioids, and muscle relaxants is another obvious area of research led by anesthesiologists. With the recent focus on pain and pain manage-

ment, and with the board certification of the anesthesiology subspecialty of pain medicine, investigation of the mechanisms of anesthesia and pain at molecular biological levels should be one of the key areas of anesthesiology research in the 21st century. Research in all of these areas should be performed with the involvement of other disciplines of basic and applied science, such as clinical pharmacology, neuroscience, molecular biology, genetics, and bioengineering. A multidisciplinary approach to anesthesia research is the key to the success and future survival of anesthesiology as an independent academic entity.

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