Chapter 1

Scope of Modern Anesthetic Practice

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Key Points

- Advances in anesthesia care and the scope of anesthesia practice have impressively facilitated the overall care of increasingly complex patient populations. This is especially important for the care of patients who are at the extremes of the age spectrum (i.e., younger and older). One indication of the expanded scope of anesthesiology is the increase in the number of chapters in this book, from 46 in the first edition (1981) to 112 in the eighth edition (2014).

- The scope of anesthesia services has expanded, in part due to the increase in the number of minimally invasive or noninvasive procedures being offered to patients. These changes in practice create both opportunities and challenges for anesthesiologists. The settings in which anesthesia is required continue to expand outside of the operating room and into ambulatory and other settings. These changes in practice require new providers with varying backgrounds and skills. These changes also provide the opportunity to identify new models of care, including telemedicine, to support the diverse patient and provider needs. A major challenge will be to continue the emphasis on safety as these new approaches to anesthesia care become less invasive but in non–operating room locations.

- Overall, national and international mandates for quality, competency, and uniform processes will change the manner in which anesthesia is delivered. More standardization and protocols will be used. These mandates will allow and require more evaluation of clinical practices and research to define the optimal approach to anesthesia and the clinical competence of the providers caring for each patient.

- The anesthesia workforce is changing as a result of subspecialization and expanded use of advanced practice nurses, anesthesia assistants, and other provider groups. The increase in nurses with advanced degrees will have added effects on the practice of anesthesiology. Team management will become more commonplace and, as a result, relationships between physicians and nurses will become a critical determinant of patient outcomes.

- Advances in anesthesia practice based on the underlying science and quality initiatives have been impressive. Although these advances have contributed greatly to the quality of patient care and to patient safety, current trends suggest that there is insufficient breadth and scope of research in anesthesiology to ensure its continued success. Anesthesiologists must be encouraged to engage in research to maintain and even enhance our academic foothold in medicine overall. There are increasing opportunities for multidisciplinary research; these approaches need to be embraced to increase the number of research-trained anesthesiologists. It is also necessary to identify alternative funding sources to support the specialty.
Chapter 1: Scope of Modern Anesthetic Practice

Since 1940, the specialty of anesthesiology has contributed greatly to major advances in health care. The contributions by anesthesiologists to the care of surgical patients have been well described in the literature. With the use of new approaches to general and regional anesthesia, new technologies to facilitate the handling of patients with complex physiologic and anatomic (e.g., airway) management and improved monitoring, anesthesiologists and surgeons have been able to provide care to an increasingly complex patient population safely and with few complications. At the same time, anesthesiologists have been instrumental in a number of other ways to improve patient care, including but not limited to new approaches to cardiopulmonary resuscitation, technical developments such as arterial blood gas machines, pulse oximetry for monitoring adequacy of gas exchange, the creation of critical care medicine as a subspecialty, and for advances in pain medicine and transfusion medicine. Each of these advances has benefited patients greatly, but they have also resulted in marked expansion of the scope of anesthesiology. Many of these advances are outlined in detail throughout the 112 chapters in this edition of the text. Each chapter also reflects the advances in the topics covered in these chapters. The book also reflects the commitment of anesthesiologists to addressing the medical needs of society in addition to providing outstanding care to individual patients. Anesthesiologists both in the operating room environment and throughout the health care system currently provide care to a considerable portion of the population in industrialized countries. Approximately 7% to 8% of the total worldwide population requires anesthetic management in association with surgical or diagnostic procedures annually. Perioperative care and anesthetic management have thus had a considerable effect on global public health and have a vital role in health care systems throughout the world. In addition, the specialty of anesthesia has extended beyond the boundaries of perioperative care to include critical care, pain management, sleep medicine, and palliative care.

Advances in diagnostic, pharmacologic, and technical resources have made it possible to provide anesthesia and perioperative care to patients at the extremes of age (i.e., both very young and very old) and to those with complex comorbidities. These systematic developments and enhancements in perioperative care have paralleled and...
perhaps facilitated an equally rapid introduction of novel surgical techniques and resources for less invasive surgical approaches. Surgical outcomes have improved considerably, allowing anesthesiology to care for patients with more advanced and complex disorders. At the same time, anesthesiology is recognized as a cornerstone within the modern hospital, extending beyond the operating room.

While most patients understand how important anesthesiology has been to their care, the Institute of Medicine (IOM) of the National Academy of Sciences has publicly praised the commitment of anesthesiology to patient safety and the successful initiatives to ensure it in the book To Err is Human. These improvements in the quality and safety of perioperative care are the result of the combined dedication of the entire profession, including both community practices and academic anesthesia departments and their training programs. The combined efforts to obtain a fundamental understanding of the mechanisms behind anesthesia and regulation of vital organ functions and the biologic processes that drive organ failure and complications in the perioperative setting have been crucial. Novel therapies and advanced monitoring equipment have improved patient safety and outcomes in the perioperative setting, pain management, and intensive care medicine.

Although the role of anesthesiology services within the health care system has expanded and the effect of anesthesia on overall quality and safety has been remarkable, health care continues to undergo radical changes that will affect the roles, responsibilities, and scope of anesthesia services in the future, within the United States and throughout the world. The involvement and role of anesthesia providers is gradually increasing within modern perioperative care processes. A more extended scope for preoperative and postoperative care includes more specialized preoperative evaluations and risk assessments with potential biomarkers of adverse outcomes. As the importance of extended and intensive postoperative care for at-risk patient populations increases, the role of anesthesiologists will expand and the practice of anesthesia and perioperative care will become more diversified. In addition, because an increasing percentage of the general population within industrialized countries is older, many with comorbidities will require diagnostic and surgical procedures, with the participation of anesthesiologists in their perioperative care becoming even more critical. In addition, as more of these patients receive complex clinical services, the financial burdens associated with care will escalate throughout the world. The increased cost will be counterbalanced with more scrutiny on the need for surgical care, the expectation that providers must document quality of care, and the requirement to use care pathways and protocols to standardize care. In a changing health care system, anesthesia and perioperative care need to have well designed quality assurance systems and outcome measures that document that the services provided are of the highest quality and safety. Relevant measures of patient outcomes, costs, and cost-benefit analysis will be required for payers, government agencies, and the general public.

Technology is also having a major effect on clinical care. In the surgical setting, technical advancement has led to less invasive and traumatic procedures with fewer negative side effects (e.g., tissue trauma, pain, risk of complications). These advancements can potentially shorten the duration of the perioperative period and subsequent need for in-hospital care. New devices are becoming available to allow remote monitoring of patients not only during and immediately after procedures, but also in the extended care and home environments. Alternative delivery systems for anesthesia will allow it to be provided in nontraditional settings beyond the operating room or procedure rooms, to the intensive care unit, other hospital units, and perhaps other clinical settings. Changes in the anesthesia workforce are also occurring, and additional will be created to facilitate the care of a larger group of patients by a collaborative group of providers working in physical proximity to the patient and, at the same time, with remote monitoring and medical direction from anesthesiologists. The involvement of advance practice nurses and other medical personnel in anesthetic practice has also allowed anesthesiologists to assume greater roles in perioperative management, rapid response teams, triage, and resuscitation outside of the operating room environment.

Electronic health records are being used worldwide, allowing for improved documentation of individual patient care and providing important data for millions of patients. Eventually, minimal to no human interaction will be required for complete data capture and integration for an automatic vigilant system. Complete integration of surgical equipment, anesthesia, and monitors of infusion pumps will enable an analysis of all patient data and clinical responses to facilitate patient care. Assessments regarding the quality of anesthesia can be made by analyzing information from large numbers of patients to evaluate outcomes of care and to facilitate the development of evidence-based clinical practices. One example is the comparative effectiveness and data-mining studies in orthopedic surgery patients; these studies have concluded that neuraxial techniques lead to superior outcomes. Furthermore, data can be collected prospectively in consecutive patients from different environments and countries so that perioperative outcomes can be compared and best practices can be identified.

Of approximately 46,000 patients in this investigation, 4% died before hospital discharge and the majority of patients who died (73%) were not admitted to a critical care unit after surgery. Conclusions from this investigation suggested that planned critical care after surgery improved outcomes as compared with unplanned admissions to critical care, which were associated with poorer outcomes. Given the more frequent incidence of perioperative mortality than expected, future investigations are planned, including similar investigations in the United States. These investigations will lead to an understanding of the factors that are important behind perioperative mortality and investigations into the treatments that lead to better outcomes.

The IOM described and evaluated the effectiveness and cost of American health care systems (Report Brief, January 2013). They have compared health care outcomes in the United States with those in the rest of the world. The United States spends more money per person than any
other country, yet ranks seventeenth in the world for life expectancy at birth. The IOM concluded that Americans fare worse in several health areas, including infant mortality, injuries, adolescent pregnancy, HIV, drug-related deaths, disability, and especially obesity and diabetes. They also noted that the United States has a larger uninsured population with lapses in the quality and safety of care outside the hospital and more frequent rates of drug abuse, violence, and use of weapons. Americans benefit less from safety net programs than in other countries. In another report (Report Brief, July 2013),6 the IOM concludes that Medicare payment (i.e., a major source of funding for American medicine) needs to “reorient competition in the health care system around the value of services provided.” These brief conclusions serve as the basis upon which major changes are occurring in health care delivery and financing, particularly regarding the need to demonstrate value. Anesthesia must understand all these changes and priorities in health care delivery and finance to define how to participate and benefit as a specialty and to retain its leadership role in quality and safety.

This summary emphasizes the implications for anesthesiology, but there are also ramifications for medicine overall, particularly in but not limited to the United States. Worldwide, the quality and expense of health care is a challenge. The changes occurring in health care obviously have implications for the role of anesthesia in both the practice and delivery of medicine overall. Some of the guidelines developed by the American Society of Anesthesiologists (ASA) document the leadership role the specialty has assumed in addressing the needs of our patients (see Chapter 112.).

As mentioned previously, the availability of large clinical databases will also prove to be a valuable tool for refining and improving clinical care. These databases will enable data mining to evaluate the process of care and approaches to identify best practices. Anesthesiology, with its expanding roles in the health care delivery system must be an integral participant in these changes. Clearly, the outcomes after major surgery need far more attention globally with sufficiently large clinical studies focusing on patient-centered outcome measures related to survival and relevant quality-of-life end points. We can only speculate as to what the practice of anesthesia will be like in the future, but these forces will likely have a major effect on the overall scope of anesthesia and perioperative care, thus creating new opportunities that anesthesiology should embrace. Analysis of current national and global priorities can provide some basis for anticipating the future of anesthesiology.7

AGING OF SOCIETY
The aging of the world’s population combined with improvements in anesthetic and surgical methods are resulting in older patients undergoing increasingly complex surgical procedures. This patient population commonly has decreased general health and organ function, and an increased incidence of chronic medical illness (see Chapter 80). In the United States, the national social insurance program, Medicare, covers more than 47 million Americans, with 39 million being older than 65 years and 8 million having disabilities (data from IOM). The use of surgical services by older patients is not unexpectedly more frequent than with younger patients. For example, in a report by the Centers for Disease Control and Prevention studying inpatient hospitalizations in the United States for 2005, there were 45 million procedures performed on inpatients with a similar number of outpatient procedures. From 1995 through 2004, the rate of hip replacements for patients 65 years and older increased 38%, and the rate of knee replacements increased 70%.

CHANGES IN LOCATION OF CARE
Because of the high costs associated with hospital care, the funding agencies (governmental and private insurance companies) are pressuring providers to perform more procedures in nontraditional settings, both within the hospital and in ambulatory and other less costly sites.8 Technology and the shift to minimally invasive procedures associated with advances in anesthesia care are facilitating this transition. Providing anesthesia in ambulatory surgical settings and out-of-hospital offices has dramatically increased over the past several decades. With this transition, it is becoming critically important to determine when an anesthesiologist or other anesthesia provider is required to provide care, when alternative providers with or without supervision might be appropriate, and the role for the anesthesiologist in defining standards of care. There are many situations when an anesthesiologist may not be required, for example in administration of conscious sedation to an otherwise healthy patient, but an anesthesiologist is the most appropriate provider in many situations. Not only are there situations in which the risks associated with airway compromise are great (e.g., deep sedation), but there are many clinical situations in which care by an anesthesiologist has been demonstrated to improve clinical outcome and often reduce overall costs of care. Anesthesiologists need to participate actively in discussions within their respective institutions or health systems to define the standards of care, implement best practices, and document clinical value.

In many cases, in part because of costs and changing capabilities, extended postoperative care has shifted from the medical setting to the home. For some families, this transition has created significant clinical and social problems. As care is moved from inpatient settings to other nonhospital settings, anesthesiologists must be involved in determining the most appropriate setting for a procedure and how to manage the transitions of care. Advances in technology can facilitate some of these changes by allowing remote monitoring, and they can create opportunities for anesthesiologists to assume a role in managing patients in these new settings.9

COST OF MEDICAL CARE
As the cost of health care in the United States approaches 18% of the gross domestic product,10 there has been an intensified interest in determining the factors that are
increasing the costs, attempting to find methods to decrease the cost, and obtaining more value for money spent. The primary cost driver in the United States appears to be technical progress, because to some extent the increases in health care costs are occurring throughout the world, regardless of the payment system.11-13 The increases in the elderly population and patients with chronic disease within that sector are also adding to health care costs.12

The escalating costs have led to pressure to get more value for the money spent. There have been pay-for-performance programs—that is, rewarding medical care that is consistent with published evidence and not paying for care that is inconsistent with evidence.15-17 For the most part, the performance measures, at least in the United States, are process measures rather than measures of outcome (e.g., for anesthesia services, administering antibiotics within 1 hour of incision rather than rates of infection). The concept of pay-for-performance and its implementation have also migrated to other countries, particularly the United Kingdom.18

In the nonsurgical arena, the concept of pay-for-performance has been studied for several years.19,20 In addition to paying for performance, in the United States there is increasing emphasis on not paying for “never” events, such as decubitus ulcers or urinary tract infections, unless they are present on admission to the hospital. The translation of this approach is lack of payment for complications, especially if they could have been prevented with better care (i.e., never events). Because of anesthesia’s role in the entire continuum of perioperative care, including postoperative intensive care and pain management, we have an opportunity to influence many of these practices, which can be associated with poor outcomes and increased cost, but which have traditionally not been considered under our domain of care. For example, appropriate and timely administration of antibiotics has a significant effect on surgical site infection, but prior to the initiation of the Surgical Care Improvement Project (SCIP), many anesthesiologists were arguing that control of antibiotics was not within their domain.21 Anesthesiologists and intensivists can also have a significant effect on the rate of ventilator-associated pneumonia or outcomes that are dependent on strategies for intravenous fluid therapy in the critically ill patients.22 However, some of these proposed measures, particularly the use of ventilator-associated pneumonia as a quality measure, have become controversial.21 Pain is considered the fifth vital sign, and the management of postoperative pain is another area in which we can have a significant effect on cost and potential interactions with other members of the hospital team.

PROCESS ASSESSMENT AND QUALITY METRICS

Anesthesiology was among the first professions to focus on reducing the risk of complications partly by developing evidence-based guidelines and standards. The American Society of Anesthesiologists standards and practice parameters are prime examples of this important direction in medicine.24 Anesthesiology should continue to be involved in these initiatives and should do so collaboratively with other disciplines, including but not limited to surgical specialties. Examples from the perspective of the United States are the involvement of anesthesiologists in the Society of Thoracic Surgeons database and the National Surgical Quality Improvement Project (NSQIP).25,26 More recently, the Society of Cardiovascular Anesthesiologists has begun discussions with the Society of Thoracic Surgeons. On the other hand, anesthesiologists have been involved from an early stage in quality initiatives with the Institute for Healthcare Improvement and the Surgical Care Improvement Project.27 Moreover, in many countries, anesthesiology has a key role in the development of quality assurance systems within prehospital care, multidisciplinary critical care, and pain medicine.

Another quality measure that will have global impact on anesthesiologists and all physicians is the new demand for documentation of competency for each clinical privilege assessed not just at the time of recredentialing, but also assessed on an ongoing basis. Defining competency will demand that medicine in general and anesthesiologists specifically adhere to more protocols; the concept of safe anesthesia includes standardization of clinical management overall, including the development and use of standardized protocols. Rather than stifling medical innovation, standardization should be viewed as a mechanism for evaluating process and outcomes; such comparisons cannot be made without standardization. Anesthesiologists will need to be leaders in creating quality and competency metrics. This opportunity can be used to formulate meaningful metrics for practicing anesthesiologists and training physicians. Such metrics will also be required for certified nurse anesthetists and other health care professionals as well. In some cases, documentation of competencies will require the use of simulation or other models to emulate the clinical environment, particularly for rarely performed procedures.

“Change process” has become a cottage industry in medical care, with courses being offered on how to change behaviors and processes in medical care. These mandates can be imposing and possibly frustrating, but they offer the opportunity for more research on identifying the processes that actually improve patient outcomes. These mandates also allow anesthesiologists to assume a leadership role in team management. To accomplish this mandate, new skills need to be taught, including leadership training, improved communication skills, and improved relationship training in the overall atmosphere of pursuing excellence in clinical care and education.

Anesthesiologists already have a long tradition with and training in system approaches to care. These approaches date back to the original checklists created over 50 years ago for the anesthesia machine. It is critical that this skill set be disseminated beyond the intraoperative setting to medicine overall. The understanding of these principles has created many leadership responsibilities for anesthesiologists in a variety of venues including surgical facilities, ambulatory surgery centers, and medical centers.
**CHANGES IN PERSONNEL**

Within the United States, there are approximately 250,000 active physicians, one third of whom are older than 55 years and are likely to retire by 2020. Although the enrollment in U.S. medical schools in the 1960s doubled, there has been no such increase from 1980 to 2005. Thus, there has been zero growth in U.S. medical school graduates. Yet, the U.S. population has increased by more than 70 million, creating a discrepancy between the supply of medical school graduates and the demand for physician-associated care. Similar developments are seen elsewhere (for more detailed description of workforce changes in Europe, see Chapter 2).

From a global perspective, the number of women in medical schools has increased, so that approximately 50% of the medical students are now women. Furthermore, independent of gender, physicians work hours have decreased over the past 40 years. To decrease the incidence of fatigue and long durations of “being on call,” the reduction in work hours is probably accounting for improved quality of care in addition to lifestyle, but it has consequences. The workforce requirements will have to increase in response to the reduced duty hours and to address the implications of the aging anesthesiologists.

A number of methods have been used within the United States to expand the workforce. There has been a steady increase in the recruitment of international medical graduates; approximately 60,000 international medical graduates are residents and constitute 25% of all residents in training. In the United States, the number of osteopathic schools and schools offering advanced degrees in nursing, including training of nurses to become nurse anesthetists, has increased. Given the growing demand for medical care partly owing to the increase in the geriatric population, this need will most likely be met by a combination of physician and nonphysician personnel.

**RESEARCH**

In terms of creative new investigations, most benchmarks suggest that the specialty of anesthesiology fares poorly in funding when compared with other disciplines, especially clinical disciplines. Using data gleaned from publicly available National Institutes of Health (NIH) sources, Reves compared the specialty with a number of other medical disciplines and produced a troubling figure showing that anesthesiology ranked second to last in funding. Disturbingly, this low ranking has existed for many years preceding Reves’s publication in 2007 and has not improved in the years since. However, the fact that anesthesiology in the United States is in the lowest quartile of NIH funding continues to be a concern, particularly because the external forces on the practice components are generally applicable to all specialties. The NIH is not the only source of funding that might influence the specialty; in fact, it is not even the largest source of total research funding in the United States (Fig. 1-2).

For all sources, there has been a doubling over the past decade in research expenditures for health and biomedical science research, although compared with biologically based disciplines, health services research is considerably less well funded. In fact, much of the clinical and some basic research are funded from other sources other than the NIH or other federal programs. These sources include foundations (e.g., Foundation for Anesthesia Education and Research) and industry and local institutional sources. Some departments have traditionally supported research by devoting some of their clinically derived incomes for research, especially for young faculty members.

The financial challenges of funding research and the increasing clinical demands of faculty in the United States are evident when reviewing the publications in peer-reviewed journals. In anesthesiology journals, the fraction of original peer-reviewed articles from non-U.S. authors has increased dramatically. The reasons for this change are probably multifactorial, but warrant evaluation. Some have suggested that European and Asian investigators are better funded than in the United States. Yet, adjusted per capita, research support in Europe is only 10% of that in the United States, even though the proportion of scientists in the population is similar. Perhaps, U.S. Food and Drug Administration (FDA) policies bear some responsibility. In the 1980s and 1990s, much “new anesthetics and drug” research started in the United States. Now, most of the new drugs are initially approved in countries other than the United States. Historically, the clinical studies with new drugs are started in the countries of initial approval, which is often not the United States. Finally, young anesthesiologists have started their research based on opportunities driven by industry-funded novel drugs, a situation that is not as readily available currently as in the past.

 Participating in research projects that advance clinical care and translate basic science to the bedside requires the
involvement of a diverse group of investigators. Practically all new frontiers lie at the boundaries of established departmental or specialty divisions, which are largely a historical relic of nineteenth-century or early twentieth-century conceptualizations. A look at any large institution’s roster of academic divisions yields a growing number of “centers,” “programs,” and “institutes,” reflecting the ever-increasing interdependency of branches in biomedical knowledge. In basic science departments, with conjugate names like Physiology and Cellular Biophysics, Anatomy and Cell Biology, Biochemistry and Biophysics, and Cellular and Molecular Pharmacology, it is becoming increasingly difficult to differentiate one faculty research program from another, solely on the basis of the topics and methods of study. Although this is clearly less complex for those domains that do not involve patient care, the trend is evident. One might cite the example of endovascular surgery as but one example in the collision of technology and historical boundaries of medical specialties. With this change in approach to advances in the specialty, anesthesiology must actively seek collaborative research environments or organizational structures that allow the development of anesthesiology research in close collaborations to relevant basic science groups and departments such as epidemiology and health policy.

Medical research is at one level original creative work that involves systemic investigation of medical phenomena with the direct or indirect consequence of improving health care. However, anesthesiology is in a position to address research questions in new and creative ways, and it has done so taking advantage of the large clinical databases to assess clinical practices, outcomes of care, and evaluate personalized medicine in defining the best way to manage an individual patient. The Anesthesia Quality Institute (sponsored by the ASA) has implemented a robust database of anesthesia care that will improve the current understanding of clinical practices and outcomes and provide valuable insights to guide future advances in care.

More than ever, anesthesiologists are involved in measuring perioperative outcomes and evaluating the comparative effectiveness of medications and techniques, as documented by an increase in the number of NIH training grants in anesthesia.

To have an influence and impact on the clinical and policy research domain, anesthesia must continue to be involved in all aspects of perioperative care. Building on these experiences, an area of potential focus for anesthesiology research is in the perioperative outcomes associated with a variety of new or controversial clinical programs that involve a variety of specialties. It is reasonable to assume that in the future reimbursement for delivery of clinical care will be tied to documentation of quality outcomes that are based on demonstrated efficacy of a procedure, such as randomized clinical trials that involve anesthesiologists and surgeons who assess efficacy and define the right patient populations to undergo a procedure. One such example is the randomized clinical trial of lung reduction surgery for patients with bullous emphysema. Similar approaches can be used to evaluate controversial or costly procedures in high-risk patients, as in the case of minimally symptomatic cerebrovascular diseases. By participating in the multidisciplinary teams, anesthesiologists can continue to exert influence in other aspects of patient care besides anesthesia and remain key contributors to defining best surgical practices.

In addition to helping define best practices and advance perioperative care, it is critical for anesthesiology as a physician specialty to remain at the forefront of basic science and clinical research. Other disciplines are becoming more actively involved in health care and health policy research, offering advanced degrees, including doctorates in their own disciplines. While their contributions are important to the overall health care needs of patients, it is critical for physicians to pursue and take leadership roles in investigative research. The various governmental and institutional bodies that regulate health care delivery and patients demand that we do so and require that we document our commitment to high-quality, safe, and efficient care—the mainstay of our specialty for the past 50 years.

Complete references available online at expertconsult.com

References

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REFERENCES


