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MILLER'S ANESTHESIA

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Miller's Anesthesia

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To all of the residents, faculty, and colleagues who have helped advance the practice of anesthesiology and who serve as the foundation upon which the eighth edition has been completed

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Preface

For more than 30 years *Miller's Anesthesia* has been recognized as the most complete and thorough resource on the global scope and practice of contemporary anesthesiology. It is used worldwide and has been translated into several languages. Since the publication of the seventh edition in 2010, the associate editors, the Elsevier publishing staff, and I have had many conversations regarding the eighth edition and how we could ensure that *Miller's Anesthesia* continued to rank as the most influential and comprehensive text on our specialty in the world. Together we gathered information from various sources and solicited comments from colleagues worldwide to evaluate the seventh edition's content. We carefully updated each chapter and introduced new chapters with topics that represent the changes and current information in anesthesiology as it evolved over the past 5 years. The results of these deliberations are presented in the pages that follow.

The eighth edition of *Miller's Anesthesia* has several new chapters that have been created in one of two ways—either by introducing topics that have grown in importance since the publication of the previous edition or by dividing a very large chapter into two smaller ones. Ten of the chapters cover topics new to this edition, such as "Perioperative and Anesthesia Neurotoxicity" (Chapter 15), "Gastrointenstinal Physiology and Pathophysiology" (Chapter 21), and "Palliative Medicine" (Chapter 65).

Historically, anesthesia has been dominated by intraoperative care. Over many years, the preoperative and postoperative periods of perioperative care have become more prominent. This development is evident in the names of our institutions as more and more anesthesia departments have changed their titles to better reflect both anesthesia and perioperative care. Accordingly, the chapters "Perioperative Management" (Chapter 3) and "Anesthesia Business Models" (Chapter 12) were included. Developments in pharmacology have necessitated a new chapter, "Nonopioid Pain Medications" (Chapter 32). Because transplantation of various organs continues to expand, "Anesthesia for Organ Procurement" (Chapter 75) has been added. The associate editors and I thought that we should look to the future by adding "Anesthesia for Fetal Surgery" (Chapter 78) and "Administration of Anesthesia by Robots" (Chapter 86). Lastly, the expansion of anesthesia administration into non–operating room settings has been occurring for many years; thus the chapter "Non–Operating Room Anesthesia" (Chapter 90) was needed.

The splitting of four large chapters has resulted in eight chapters that are of greater focus. This has allowed us to more thoroughly present material that reflects current knowledge in these subjects. The following shows how these new chapters were created:

Seventh Edition Chapter	*Eighth Edition Chapters*
11. Sleep, Memory, and Consciousness	13. Consciousness and Memory 14. Sleep Medicine
29. The Pharmacology of Muscle Relaxants and Their Antagonists	34. Pharmacology of Neuromuscular Blocking Drugs 35. Reversal (Antagonism of Neuromuscular Blockade)
37. Neuromuscular Disorders and Malignant Hyperthermia	42. Neuromuscular Disorders and Other Genetic Disorders 43. Malignant Hyperthermia and Muscle-Related Disorders
75. Anesthesia for Eye, Ear, Nose, and Throat Surgery	84. Anesthesia for Eye Surgery 85. Anesthesia for Ear, Nose, and Throat Surgery

The separation of these topics into two chapters has another noteworthy benefit; we have added to our list of experts new authors who are recognized authorities in their specialties. Also, three chapters devoted to transfusions and coagulation have been placed in the overall category of "Patient Blood Management" (Chapters 61, 62, and 63).

As we proceeded with this book, a unique opportunity was presented to us and resulted in Chapter 112, "Evaluation and Classification of Evidence for the ASA Clinical Practice Guidelines." For many years, the American Society of Anesthesiologists (ASA) has developed practice guidelines on a broad spectrum of clinical and anesthetic specialty activities. These guidelines have been developed based on a well-defined process that incorporates input from many sources, including extensive examination of the literature and clinical insights from anesthesia practitioners. We think that the ASA guidelines have had considerable positive influence on our clinical practices and that it is important to document and understand their history and the course by which these guidelines were developed. We are grateful to Richard T. Connis, David G. Nickinovich, Robert A. Caplan, and Jeffrey L. Apfelbaum for organizing these guidelines for the current edition of this book.

The revision of the table of contents and the selection of authors was a very intense process. Initially, the associate editors, the publishing staff, and I discussed the new table of contents and potential authors online. We then met as a group to carefully review and select subject matter experts. Often the authors who wrote a chapter for the seventh edition were asked to do so for the eighth edition. To ensure that submitted chapters were updated and met our quality standards, we initiated a very thorough review process that included the associate editors, editorial analyst Tula Gourdin, and myself. After our reviews were completed, the manuscript for each chapter was then sent to the publisher for further review and creation of the page proofs. From there, all chapters were sent through a final review cycle by the editorial staff and the authors. We tenaciously adhered to this rigorous and comprehensive editorial process so that we could present an international text like no other in our field. This edition is a collection of the knowledge and experience of some of the world's most renowned anesthesiologists. It thoroughly covers anesthesiology, its subspecialties, and related subjects, and its content is brought to our readers with our upmost attention to quality and veracity.

We are especially proud of Chapter 2, "International Scope, Practice, and Legal Aspects of Anesthesia." This chapter was introduced in the previous edition and continues in this edition with new and updated content. In this edition, we elicited individual contributions from leaders in anesthesiology all over the world. Each contributor describes the development and current status of anesthesiology in his or her region or country. The following have been added for this edition:

1. Discussions of anesthesiology in Brazil by Maria J.C. Carmona
2. New coauthors for Japan (Naoyuki Hirata), Europe (Jannicke Mellin-Olsen), and Russia (Yury S. Polushin)
3. A section on safety and medicolegal initiatives in various regions of the world

A significant number of the chapter authors are from countries other than the United States. All of our decisions regarding this edition were made with the strong motivation to make this text truly international. Fortunately, the increasing prominence of information technology has facilitated the transfer of clinical concepts globally; so with just a handful of exceptions, most countries are no longer intellectually isolated.

Miller's Anesthesia, eighth edition, includes access to the Expert Consult website, allowing users to view the complete text online from any computer and to download the electronic book to a smartphone or tablet. Fully searchable and containing references linked to PubMed abstracts and full-text articles, the website is a powerful tool that gives the reader access to interactive content and a seamless integration between devices. In addition, Expert Consult offers the reader regular content updates and an extensive video library that features video presentations of anesthesia procedures, including airway and ultrasound-guided regional anesthesia techniques.

In addition to our authors, the associate editors of *Miller's Anesthesia* are recognized internationally for their contributions to anesthesiology. One of our associate editors, William L. Young, MD, passed away at the beginning of the review process for this edition. The Remembrance section summarizes Bill's enormous contributions to anesthesiology and his passion for jazz music. During our concerted efforts with writing, editing, and developing the eighth edition, Dr. Young's influence and dedication to excellence were always present.

We wish to express our appreciation to the individual contributors of this 112-chapter book, including those authors from previous editions whose contributions laid the foundation for this edition. *Miller's Anesthesia* would not have been possible without their hard work and dedication. We also acknowledge the contribution of time and expertise by the associate editors, Neal H. Cohen, Lars I. Eriksson, Lee A. Fleisher, and Jeanine P. Wiener-Kronish, and William L. Young. We are grateful for the ongoing efforts of editorial analyst Tula Gourdin, who managed communication with the contributors and the publisher, facilitated the flow of manuscript and page proofs, and checked every detail to ensure that the chapters are as accurate and consistent as possible. We also wish to acknowledge our publisher, Elsevier, and the help and dedication of their staff, in particular executive content strategist, William R. Schmitt; senior content development specialist, Ann Ruzycka Anderson; and senior project manager, Doug Turner.

RONALD D. MILLER, MD, MS

Remembrance

William L. Young, MD
August 6, 1954–August 1, 2013
(Pictured at the UCSF Department of Anesthesia's Fiftieth Anniversary Gala on November 15, 2008)
Professor and Vice Chair
Department of Anesthesia and Perioperative Care
Professor of Neurological Surgery and Neurology
Director, Center for Cerebrovascular Research
University of California, San Francisco, School of Medicine
Associate Editor, *Miller's Anesthesia,* editions six through eight
(Courtesy Christine Jegan.)

William L. Young, MD, the James P. Livingston Endowed Chair in the Department of Anesthesia and Perioperative Care at the University of California, San Francisco (UCSF), was an accomplished anesthesiologist and prolific investigator. His work has had an impact on the scholarly development of neuroanesthesia and on our ability to understand the mechanisms, pathophysiology, and care of patients with neurovascular disease.

In 2009 he was awarded the American Society of Anesthesiologists (ASA) Excellence in Research Award, the highest honor that the ASA can bestow on an investigator, and it is hard to imagine a more deserving colleague. He was instrumental in establishing the multidisciplinary UCSF Center for Cerebrovascular Research, which has been the vehicle for extending the boundaries of our specialty's influence to include neurosurgery, radiology, neurology, and other various neuroscience fields. When interviewed for our department's fiftieth anniversary, Bill said, "Ultimately, the current status of our specialty should be an effect—not a cause—of the questions we ask, and our reach should exceed our grasp." It is this approach that distinguished his career and points the way for anesthesiology to continue to thrive.

Bill grew up in Munster, Indiana, and coincidentally we both attended medical school at Indiana University. In 1985, after clinical anesthesia training at New York University Medical Center, he joined the faculty at the Columbia University College of Physicians and Surgeons, where he had completed clinical and research fellowships. He quickly grew into a productive and successful National Institutes of Health (NIH)–funded investigator in the specialty of anesthesiology. In 2000 he relocated to UCSF where he became the James P. Livingston Professor and Vice Chair of Anesthesia and Perioperative Care. His unwavering dedication to excellence had an enormous impact on faculty members in our department and across the entire UCSF campus. His productivity in research and NIH grant funding was incredibly consistent. He had continuous NIH funding since 1990, two concurrent NIH grants since 1994, and at least three—and up to five—NIH grants concurrently since l999. He was one of the most prolific recipients of NIH grants in the history of anesthesiology.

He was the principal director of a program project grant, "Integrative Study of Brain Vascular Malformations," which was renewed in 2009 for a second 5 years. Bill's remarkable run began when he was an early recipient of the Foundation for Anesthesia Education and Research (FAER) award system; his success supported the direction that FAER and the ASA pursued in those days. Bill's focus and calm dedication to excellence were inspiring to me personally, and he served as a role model for the entire UCSF faculty.

The substance of his research was even more impressive. From his early studies on the cerebral effects of anesthetics, he gradually moved to more unexplored pathophysiologic areas in anesthesia, neurocritical care, and intraoperative neurosurgery. This led to the understanding of reperfusion hyperemia, or perfusion pressure breakthrough, which is associated with arteriovenous malformation treatment. This work also led to epidemiologic, clinical risk prediction, and imaging studies. When he arrived at UCSF from Columbia University, Bill

approached cerebrovascular biology of vascular remodeling and angiogenesis using molecular and genetic techniques. Studying patients with giant cerebral aneurysms, he used network models, including innovative collaborations with bioengineers and imaging scientists.

Bill was someone the NIH would turn to when it needed leaders. From 1997 until his death, he served on various NIH review committees. In 2005 he became a member of the Clinical Neuroscience and Disease Study Section. In 2008 he was selected to co-chair the first-ever National Institute of Neurological Disorders and Stroke (NINDS) workshop on vascular malformations of the brain. The workshop, which took place in Madrid, involved a gathering of some 50 international clinical and basic science experts. In addition, Bill was instrumental in expanding the number of anesthesiologists conducting high-level basic and clinical research—filling a critical need that was well recognized by ASA leadership and several Rovenstine Lecturers.

He had remarkable success in helping junior faculty obtain career development awards and served as primary mentor on seven NIH-funded K awards (K08, K23, and K25) and three American Heart Association development awards. He was one of the first to be recognized by the NIH for mentoring efforts by receipt of a K24 award in 1999. Several of his trainees are faculty in institutions that include Columbia, Cornell, and UCSF.

His editorial responsibilities were also extensive, having served on the editorial boards of the *Journal of the American Heart Association, Stroke,* and *Neurosurgical Anesthesia*, as well as on the associate editorial board of *Anesthesiology* earlier in his career. He was also the coeditor of a major text, *Cerebrovascular Disease*, and an associate editor for the sixth, seventh, and eighth editions of *Miller's Anesthesia*.

Perhaps the most intriguing evidence of Bill's multifaceted approach to his work and his world was that he was a passionate and professional-level jazz pianist. Being a pianist myself, I was stunned by the complexity and innovation of the many chord progressions he used in his jazz music. When he moved to San Francisco, he gravitated toward the jazz scene and easily worked his way into jam sessions with some of our city's superb professional jazz musicians. And for our department's fiftieth anniversary party with more than 300 attendees, he provided our after-dinner music. Why hire someone else when Bill could do the job as well as anyone?

By using the unique skillsets gained from his training in anesthesia, Bill Young made major contributions to understanding both the biology and the management of neurovascular disorders that many anesthesiologists must manage. He would say, "If anesthesiologists take care of vascular disease patients, then we should strive to understand the totality of the disease process and not accept any *a priori* limitations to the nature of the questions we ask nor investigations we pursue." Indeed, his search for answers began at the bedside, thus instigating the most innovative and productive physiologic approach to understanding these disorders to date, and he continued to conduct this search at the level of program director of an NIH program project grant at the time of his death. Reaching the limits of current physiologic technology, Bill recognized real progress would only occur through a thoughtful laboratory and bedside approach.

For all of these reasons and more, my colleagues and I remember Bill Young and the life he led, which was one of dedication to excellence in all he did.

Ronald D. Miller, MD, MS

Chapter 1

Scope of Modern Anesthetic Practice

LARS I. ERIKSSON • JEANINE P. WIENER-KRONISH • NEAL H. COHEN • LEE A. FLEISHER • RONALD D. MILLER

Acknowledgment: The editors and the publisher recognize the contributions of Dr. William L. Young, who was a contributing author to this topic in prior editions of this work. It has served as the foundation for the current chapter.

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.

Figure 1-1. Changing scope and settings of anesthesia and perioperative medicine. **A,** *The Cure of Folly,* by Hieronymus Bosch (c 1450-1516), depicting the removal of stones in the head, thought to be a cure for madness. **B,** Friedrich Esmarch amputating with the use of anesthesia and antisepsis. **C,** Harvey Cushing performing an operation. The Harvey Cushing Society is observing (1932). **D,** Placement of a deep brain stimulator for the treatment of Parkinson disease using a real-time magnetic resonance (MR) imaging technology (MR fluoroscopy). The procedure occurs in the MR suite of the radiology department. The patient is anesthetized (**D**) and moved into the bore of the magnet (**E**). A sterile field is created for intracranial instrumentation (**F**), and electrodes are placed using real-time guidance (**G**). *(**A,** Museo Nacional del Prado, Madrid. **B,** Woodcut from Esmarch's* Handbuch Der Kriegschirurgischen Technik *[1877]; Jeremy Norman & Co. **C,** Photograph by Richard Upjohn Light (Boston Medical Library). **D to G,** Courtesy Paul Larson, University of California–San Francisco, San Francisco Veterans Administration Medical Center.)*

SCOPE OF ANESTHESIA AND PERIOPERATIVE CARE IN HEALTH CARE AND FORCES THAT WILL CHANGE PRACTICES (Fig. 1-1)

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*.[1] 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.[2,3] 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.[4] 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).[5] 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 rather than the volume 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 anesthesiology 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.[23] 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.[28] 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.[29,30] Furthermore, independent of gender, physicians work hours have decreased over the past 40 years.[28,31] 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 work force. 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.[32] 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.[28] 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[33] 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).[34] 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.

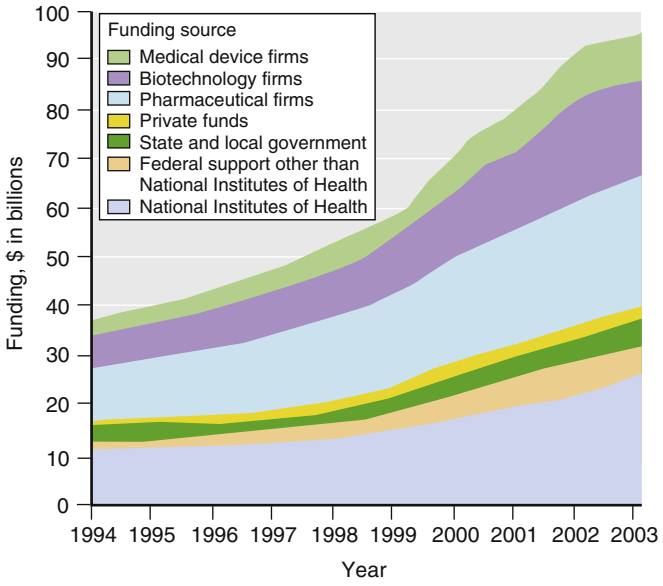

Figure 1-2. U.S. Research expenditures, 1994 to 2003, by funding source. *(From National Center for Health Statistics: Health, United States, 2007, with Chartbook on Trends in the Health of Americans. <http://www.ncbi.nlm.nih.gov/books/bv.fcgi?indexed=google&rid=healthus07.chapter.trend-tables>; National Center for Health Statistics: Health, United States, 2007 With Chartbook on Trends in the Health of Americans Hyattsville, MD: 2007. <http://www.cdc.gov/nchs/hus/previous.htm.>(Accessed 19.05.14.))*

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.[35] 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, many 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.[36,37] 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 complicated 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.[38] 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 anesthesia 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.[39] Similar approaches can be used to evaluate controversial or costly procedures in high-risk patients, as in the case of minimally symptomatic cerebrovascular diseases.[38,40] 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.

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Chapter 2

International Scope, Practice, and Legal Aspects of Anesthesia

RONALD D. MILLER, EDITOR

Acknowledgment: The editors and publisher would like to thank Akiyoshi Namiki (Japan), Olga N. Afonin (Russia), and Peter Simpson (Europe) for their contributions to the seventh edition of this chapter and Andrew Schwartz (editor) for his contribution on the entire chapter. Their contributions have served as the foundation for the current chapter.

Chapter Outline

†Deceased.

Chapter Outline—cont'd

At an international anesthesia conference several years ago, the value of using modern electronic monitoring devices in the operating room was emphasized. Because appropriate monitoring (see Chapter 50) improves patient safety, the speaker hoped that hospitals worldwide would adopt and use these devices. During the question and answer session, however, a physician from another country—one whose hospital resources were limited—expressed his frustration and disagreement with this argument. In his country, he believed, there were other priorities and the sheer cost of monitoring equipment prohibited its widespread adoption. Another physician, also from a country whose hospitals had limited resources, disagreed; he argued that by understanding what monitoring devices were available, he would pick the most effective equipment in accordance with his hospital's limited resources. A spirited exchange ensued. Of course, there is no single correct way for hospitals to spend their limited resources. There was, however, enormous value in this exchange among physicians from different countries with distinct cultures, resources, and perspectives. With these types of discussions, the profession can create fully informed baseline standards that foster more successful levels of patient safety and improved outcomes worldwide.

Such discussions also inspired this chapter on the international or global scope and practice of anesthesia. Throughout the career of this book's editor, Ronald D. Miller, he has had the privilege and pleasure of speaking and working with leading anesthesiologists from all over the world. His work and discussions with international colleagues spurred a desire to recognize and honor the growth and practice of anesthesia outside North America. He wanted to describe the different ways that anesthesia began from place to place and to follow the regions through time so that we can better understand how the various regions influence each other today.

This chapter is the first step in realizing Dr. Miller's hope. Work on this chapter began in earnest when the editor invited a number of colleagues whom he had met over the years—prominent anesthesiologists in their parts of the world—to contribute a short summary describing the growth and practice of anesthesia in their country or region. When the contributions arrived, they proved to be a fascinating read: creative, informative, and inspirational. Yet for all their rich content, they also posed an editorial challenge in that the unique geographic features, cultures, politics, economics, and developments in various regions prompted the contributors to emphasize different ideas, discoveries, or time periods. These differences in emphasis and coverage reflect the freedom that the contributors were given to describe their country or region. In the future, we hope to expand on this topic by covering other areas of practice and including world regions not featured in this chapter.

It was in the face of this challenge that Dr. Schwartz was asked to integrate the short individual contributions into a single chapter without compromising their integrity in the seventh edition of *Miller's Anesthesia*. Dr. Miller and Dr. Schwartz chose to create a chronologic narrative that progresses through three distinct periods. Each period is discussed by region; each regional narrative draws directly from the work of the international contributors. Our intent was to always acknowledge and document the sources and wherever possible maintain each contributor's individual voice, and we hope that we have achieved that goal. Because this chapter was so successful, the associate editors and Dr. Miller decided to retain and update it.

Dr. Miller is deeply grateful to all the colleagues who contributed to this chapter, for their insightful writing and the time that they devoted to their tasks, with the only regret that more contributions of this kind could not be included in this edition because of time and space constraints. This chapter represents a preliminary endeavor and by no means a comprehensive look at the development of anesthesia around the world. Future editions will deepen and broaden the international focus.

The first section of this chapter is a sprint through a vast stretch of history, from ancient times through the early twentieth century. Over these 2000 or so years, with a few notable exceptions, the practice of anesthesia grew independently by region in response to the need for pain relief during medical procedures.

The second section covers the period from the 1920s through the early 1980s. Modern communications and international travel expanded dramatically during this period, leading to increased cross-pollination of anesthesia techniques. Physicians and researchers began to travel regularly to foreign countries, receive training and education abroad, and hear others speak at conferences. As the number of international journals increased, knowledge about emerging practices in anesthesia spread further.

The third section covers the time from the late 1980s through the present. This period has been exciting because today nearly all anesthesiologists, no matter where they practice in the world, can gain access to the information necessary to deliver safe anesthesia at the most basic level. Although there are still significant differences in resource levels, some of which undermine the practice of safe anesthesia, at least all anesthesiologists worldwide today know how to avoid the common complications of anesthesia that can endanger patients' lives. This section details the state of anesthesia in the regions covered—from education, accreditation, professional exchanges, and actual practice to available facilities and equipment. No matter how remote a clinician may be, access to a computer will enable the use of the most current principles of perioperative care. Knowledge should no longer be a limiting factor. Unfortunately, limited financial resources can constrain the availability of modern technology.

A fourth section has been added to cover safety and medicolegal aspects. To accommodate the contribution of one of our authors, a future considerations section has also been included.

The chapter concludes by raising questions about what is next in terms of the way various countries and regions practice anesthesia. How integrated should the practice of anesthesia become? What can be done to increase the quality of care worldwide? Certainly many international organizations have tried to enhance the quality of patient care worldwide, which this author recognizes. Leading authors from around the world have been asked to describe the evolution and status of anesthesia in their respective countries. Although there are no simple answers, learning from each other will enhance the transfer of information and knowledge worldwide.

EARLY HISTORY OF INTERNATIONAL ANESTHESIA

Before the early twentieth century, transfer of information internationally was obviously limited. This editor thought that a comparison of the evolution of anesthesia in different countries would not only be interesting, but also educationally instructional regarding the effects of societal pressures and clinical needs on its development. In response to patient needs, physicians from various regions came to different but often similar conclusions about pain relief and surgical anesthesia. In many places, herbs, opium, and alcohol were the mainstays of pain relief medication.

Regions were not completely isolated, however. As the narratives herein describe, the traditional ways of spreading culture and information, such as war, trade, and immigration, enabled at least some sharing of anesthesia techniques. In particular, the first published account of ether used as an anesthetic in 1846 seems to have been a watershed for the field of anesthesia.

BRAZIL (Maria Carmona)

The first ether anesthesia in Brazil was administered in the Military Hospital of Rio de Janeiro by Dr. Roberto Jorge Haddock Lobo on May 25, 1847. Ether was soon replaced by chloroform, which became widespread until other new anesthetic drugs were discovered and introduced into medical practice. Until the early twentieth century, anesthesia was delivered primarily by nurses and surgeons.

INDIA (Deepak K. Tempe)

The history of anesthesia in India dates back to the era of Susruta, the great surgeon of ancient India. During his time, around 600 BC, operations were performed with the use of opium, wine, and Indian hemp (an herb). Surgical science was called *salya-tantra* (*salya*: broken parts of an arrow and other sharp weapons; *tantra*: maneuver).[1]

Much later, in AD 980, Pandit Ballala mentioned in *Bhoj Prabandh* that Raja (King) Bhoj underwent a cranial operation under the anesthetic influence of a plant called *sammohini*. The same plant was applied as a healing balm to surgical wounds. A drug called *sanjivan* was administered to revive the Raja and help him regain consciousness.[2]

Nearly 900 years later, after the first widely publicized demonstration of ether anesthesia in the United States in 1846, India quickly followed suit by administering ether anesthesia on March 22, 1847, in Calcutta under the supervision of a surgeon named Dr. O'Shaughnessy.[3] Later, chloroform was also used but fell into disrepute because of the frequent morbidity associated with it. Despite this morbidity—and the fact that the world began to discard chloroform in preference for ether by 1890—India continued to use chloroform until 1928.

Among the several interesting case reports related to anesthetic practice is the emergency appendectomy performed on Mahatma Gandhi on January 12, 1925, at Sassoon Hospital, Pune (Fig. 2-1). During an electricity failure, the mahatma was administered open-drop chloroform anesthesia, with the surgery being completed by the light of a kerosene lamp and battery-operated torch.[4]

JAPAN (Naoyuki Hirata and Michiaki Yamakage)

In Japan, it is believed that Seishu Hanaoka (Fig. 2-2, *A*) probably first introduced general anesthesia for surgery on October 13, 1804, which was 42 years before W. Morton introduced ether anesthesia to the world.[5] Hanaoka achieved general anesthesia using an herbal concoction

Figure 2-1. Mahatma Gandhi after surgery with the surgeon Col. C. Maddock. *(Courtesy Professor Kalpana Kelkar, Head of Anesthesiology, Sasoon Hospital, Pune, India.)*

Figure 2-2. A, Seishu Hanaoka (1760-1835), the Japanese pioneer of anesthesia and surgery. **B,** Seishu's disciple recorded his first operation (mastectomy, *bottom*) using general anesthesia performed on Kan Aiya (*top*). *(With permission from Wakayama prefecture and Naito Museum of Pharmaceutical Science and Industry.)*

Figure 2-3. A, *Datura alba* was the primary ingredient of mafutsusan, which was the first general anesthetic produced by Seishu. **B,** *Datura alba* is now a symbol of the Japanese Society of Anesthesiologists (JSA).

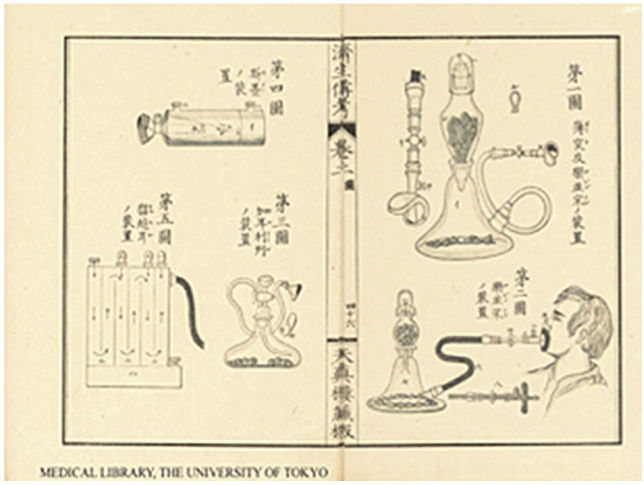


Figure 2-4. Seikei Sugita introduced materials and methods of ether anesthesia to Japan in 1850 by translating Dutch text. *(With permission from Medical Library of Tokyo University.)*

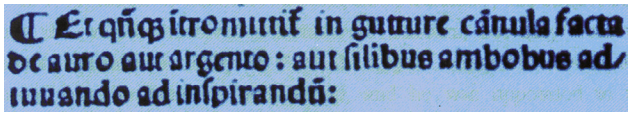
called *mafutsusan*, which mainly contained *Datura alba*, for Kan Aiya, a female patient with breast cancer (see Fig. 2-2, *B*). Hanaoka's colleagues recorded the anesthetic and surgical courses. According to these records, after mafutsusan was administered orally, the patient became drowsy and lost consciousness; Hanaoka then performed a mastectomy without any patient movement. After several hours, the patient recovered from anesthesia. However, the patient died 4.5 months after the surgery. After this first general anesthesia for performing a mastectomy, Hanaoka improved his surgical and anesthetic skills and performed over 200 surgeries using general anesthesia. He accepted many medical students to his school and instructed them privately. At that time, Japan closed its doors to most of the outside world. Therefore, Hanaoka's method had little effect on Western medicine. Nevertheless, Hanaoka's surgical and medical treatments spread widely throughout Japan and prepared the way for the rapid and smooth acceptance of modern Western surgery. *D. alba*, the main component of mafutsusan, is now a symbol of the Japanese Society of Anesthesiologists (JSA; Fig. 2-3).

Forty-six years after Hanaoka's first use of general anesthesia, Seikei Sugita introduced ether anesthesia to Japan in 1850. He translated the Dutch text by J. Sarluis that described the methods and materials of ether anesthesia (Fig. 2-4). The Dutch text was not original but was translated from the German text by J. Schlesinger in 1847.[5a] As mentioned previously, Japan limited its contact with the outside world in those days. Japan was conducting trade with only China and the Netherlands. Therefore, Japan obtained information and knowledge about Western medicine from the Netherlands in the 1800s.

THE MIDDLE EAST (Anis Baraka and Fouad Salim Haddad)

With the decline of the Greco-Roman Empire in the fifth century AD, the Middle East witnessed the rise of an Arab/Islamic civilization that within 100 years (AD 632-732) expanded over a 3000-mile stretch extending from the

A



B

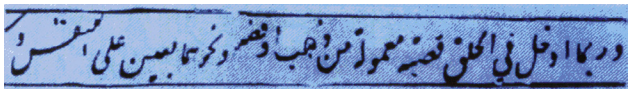


Figure 2-5. A, The Latin version of oral intubation: *Et quandoque intromittiture in gutture canula facta de auro aut argento: aut silibus ambobus, adjuvando ad inspirandu.* **B,** The Arabic version of oral intubation; it translates as, "When necessary, a cannula made of gold, silver, or another suitable material is advanced down the throat to support inspiration." *(From Haddad FS: Ibn Sina [Avicenna] advocated orotracheal intubation 1000 years ago: documentation of Arabic and Latin originals.* Middle East J Anesthesiol *17:155-162, 2000.)*

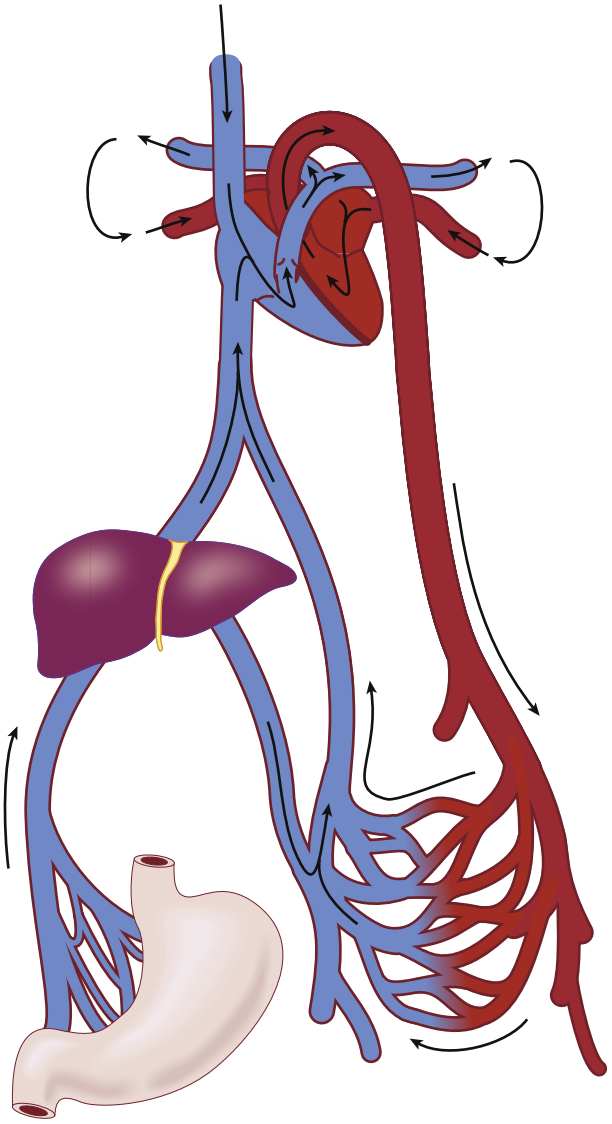
western borders of India, through northern Africa and Sicily, to Andalusia on the Atlantic coast of Spain. This civilization interacted with the ancient Egyptian, Hellenistic, Byzantine, Syrian, Persian, and Indian cultures. Many Arab/Islamic, Christian, and Jewish scholars translated, refined, and augmented the knowledge contained in these cultures. The new civilization that evolved lasted for approximately 1000 years, carried the torch of knowledge in the Middle Ages, and through its transmission via Spain and Sicily, contributed to the European Renaissance.

In this epoch, some prominent Arab/Islamic, Christian, and Jewish scholars made important contributions in the fields of medicine, philosophy, astronomy, mathematics, and chemistry. A wealth of knowledge was thus inherited by several succeeding ages. Of special interest, the following scholars made contributions to the field of anesthesia. First, Al-Rhazi (AD 865-925), born in Ray, Persia, described the pupillary reaction to light and the laryngeal branch of the recurrent laryngeal nerve.[6] Second, Avicenna (AD 980-1037), born near Bukhara, Persia, enumerated drugs that alleviate pain: opium, henbane, and mandrake; in his *Canon of Medicine*, he advocated oral endotracheal intubation: "When necessary, a cannula of gold, silver, or another suitable material is advanced down the throat to support inspiration" (Fig. 2-5).[7,8] Third, Ibn al-Nafis (AD 1208-1288), born in Quresh, near Damascus, Syria, criticized in his *Sharh Tashrih Al Qanou* Galen's theory of blood movement, which said that blood from the right ventricle passes into the left ventricle through small invisible pores in the septum (Fig. 2-6, *A*). Ibn al-Nafis asserted that there is no direct pathway between the chambers and the thick septum of the heart is not perforated, and he described the pulmonary circulation as we know it today (see Fig. 2-6, *B*).[9,10] And fourth, Al-Khawarizmi (died AD 840), born in Balkh, Persia, was a famed mathematician; the word *algorithm,* a mathematical tool, is attributed to him. Algorithm is defined as "a step-by-step problem-solving procedure."[11]

Use of Spongia Somnifera

In the Middle Ages, the concept of inhalation to induce sedation before surgery with use of the sleeping sponge, or *spongia somnifera*, is attributed to Arab origins.[12,13]

A



B

Figure 2-6. A, Galen's theory of blood movement. According to Galen, blood reached the periphery through the veins (most of it departing from the liver), as well as through the arteries (departing from the heart). Little blood went to the lungs from the right ventricle of the heart. He thought that most of the blood passed from the right to the left ventricle through pores in the intraventricular septum. **B,** Photographic reproduction of the original manuscript of Ibn al-Nafis, denying the presence of intraventricular pores and describing the pulmonary circulation.

With the Arab conquest of Sicily in the ninth century and the Latin translations of Arabic medical books that followed, Arabic medicine, including the soporific sponge, took hold in southern Italy (Salerno, Monte Cassino). From there it spread to other parts of Europe and was used in the Middle Ages.[13] A probability also exists that it was carried from the Andalus of Spain by Michael Scot, who in the thirteenth century transmitted scientific culture from Toledo to Bologna via the Court of Frederick II Hohenstaufen in Sicily.[14,15]

After the Middle Ages, major political events in the nineteenth century affected the development of medicine throughout the countries of the Middle East. First, with Napoleon's invasion of Egypt in 1798, the medical awakening of Middle Eastern countries to Western medicine can be said to have started. To win the cooperation of the Egyptian people, Napoleon brought with him men of all specialties.[16] After Napoleon's departure from Egypt and the assumption of power by Mohammad Ali in 1805, efforts to propagate knowledge and education continued. Mohammad Ali brought doctors from Europe and France to take care of the health of his army. Of those, the most remarkable was Dr. Antoine Berthelemy Clot (later Clot Bey) (1793-1868), who was brought to Egypt in 1825. In 1835, Bey established a medical school in Kasr Al Aini Hospital in Cairo, the only Arab medical school in the Middle East at the time.[16]

The developing renovation of Egypt then influenced other regions of the Middle East, either through students flocking to study medicine in Kasr Al Aini Hospital or through the influence of the Egyptian military campaign (Ibrahim Pasha, son of Mohammad Ali) against the then known Syria (1831-1840). Graduates from the medical school in Cairo practiced in all big cities of the Middle East: Beirut, Damascus, Allepo, Jerusalem, Safad, Nablus, Haifa, and Nazareth. It is assumed that the analgesia practiced in major cities of the Middle East was the same technique used in Cairo. Relief of surgical pain in Cairo then consisted of herbal medications and antispasmodics.[16] No kind of inhaled anesthesia was known.

After the invasion of Syria by Ibrahim Pasha from 1831 to 1840, the Egyptians, with the influence of Western missionaries, built two military hospitals—one in Allepo and one in Damascus—and established free medical clinics.[16,17] The presence of Clot Bey in the campaign was instrumental in sending the first five Lebanese students to study medicine at Kasr Al Aini Hospital.[16]

Finally, after massacres in 1860, Western powers (American, French, and British) intervened in Lebanon, and with the inflow of missionaries, more medical schools and hospitals were established. In 1866, the Americans founded the Syrian Protestant College, which in 1920 became the American University of Beirut. In 1883, the French founded their medical school (Faculté Française de Médecine).[16]

Introduction of Modern Anesthesia to the Middle East

In 1846, the first published account of the use of ether anesthesia for a surgical operation appeared, and the innovation spread rapidly,[18,19] including to London in December 1846 and Paris in January 1847. Twenty-seven years later, in 1873, anesthesia arrived in Beirut[16] with the help of an American surgeon, Dr. George Post (Fig. 2-7, *A*).

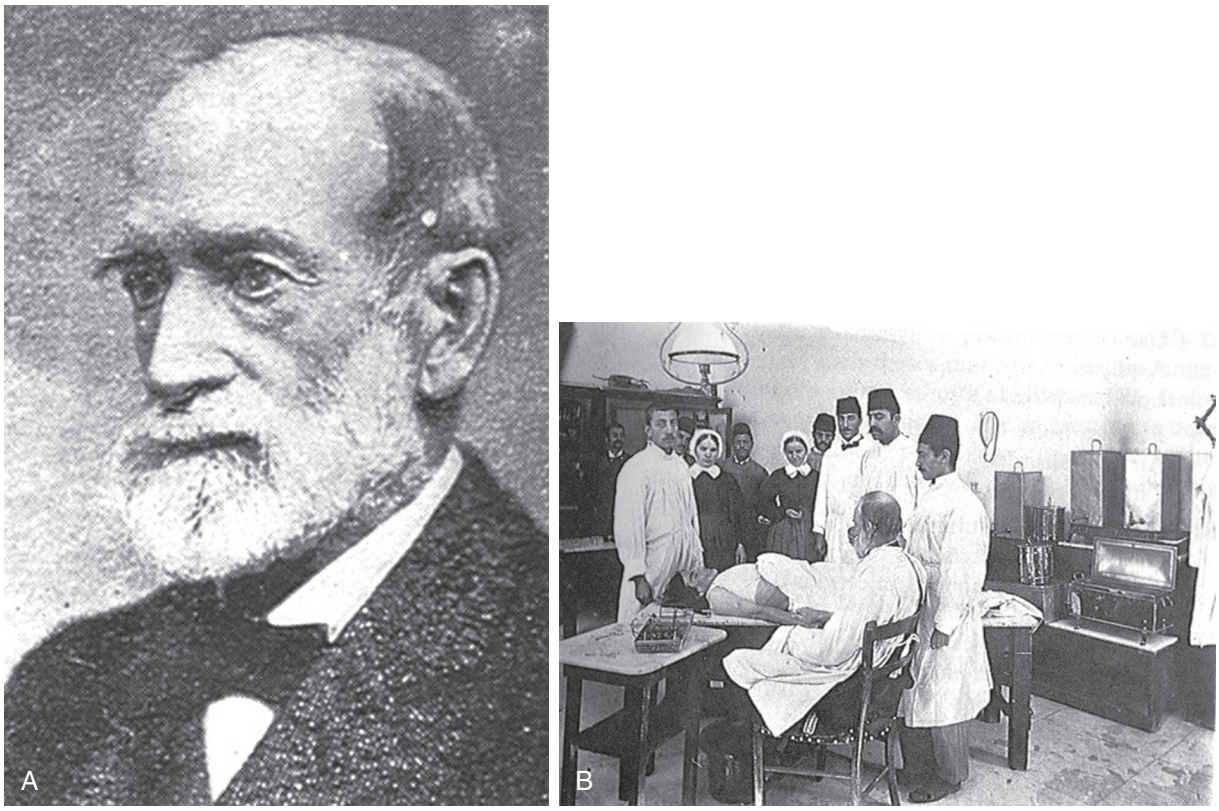


Figure 2-7. A, Dr. George Post (1838-1909). **B,** Dr. George Post in the operating room with a female patient on the operating table.

Dr. Post arrived in Lebanon in 1863 to assist with missionary work. In 1867, he and others established the medical school of the then Syrian Protestant College, and in 1873, Dr. Post wrote a book on surgery in the Arabic language, which included a chapter on general anesthesia, the first of its kind in the Middle East. This chapter described the administration of chloroform. This anesthetic facilitated the ability to reduce a dislocated shoulder of a patient, which was performed at the Syrian Protestant College's Johanniter Hospital in Beirut. To describe this action, Dr. Post coined the word *kulfera,* an Arabization of the word *chloroform*. Dr. Post rightly deserves the title of the First Pioneer of Modern Anesthesia in Lebanon and the Middle East (Fig. 2-7, *B*).[16]

Graduates of the Syrian Protestant College in Lebanon and other graduates of medical schools in the Middle East probably administered open-drop ether or chloroform along with local and spinal anesthesia through the rest of the nineteenth century and middle of the twentieth century. Physicians, students, nurses, nuns, and technicians were most likely also involved.

RUSSIA (Yury S. Polushin)

The history of Russian medicine has its roots in the history of medieval European medicine. Right through the eighteenth and nineteenth centuries, much of the information about anesthetic techniques—applying "snow" 15 minutes before surgical procedures and analgesics for the cardiovascular and respiratory systems and wound healing, as well as the use of bellows for lung ventilation—came from various leaders in European medicine. In addition, like their colleagues in the Middle East and India, Russian physicians heard of the first use of ether on October 16, 1846; that day is still a professional holiday for anesthesiologists in Russia. A brief 4 months later, Dr. F. I. Inozemtzev of Moscow became the first in Russia to use ether for anesthesia during surgery.

Around the same time, the art of local anesthesia was developing rapidly after the publication of an article by the Russian doctor Vassili von Anrep. He described the effects of cocaine as a topical and subcutaneous local anesthetic in 1879. Isolated by the German chemist Friedrich Gaedcke in 1855 and purified by University of Gottingen student Albert Niemann in 1859, cocaine was first given to a patient in 1884. It was the only local anesthetic until 1904, when procaine was synthesized.

Von Anrep's ideas of local anesthesia were highly popular. Famous physicians of Europe and Russia (Shleich, Lukashevich, Vishnevskiy, Bier) were developing the knowledge of local anesthesia, which gave rise to new methods of preventing pain: local field anesthesia, local infiltration anesthesia, nerve blocks, plexus anesthesia, intravenous anesthesia, and neuraxial anesthesia.

In general anesthesia, Nikolay Pirogov (1810-1881) was a prominent Russian physician and surgeon, well known in Europe. He was the first to describe the negative effects of general anesthesia and the possibility of severe complications. He postulated the necessity of acquiring detailed knowledge of the physiologic and clinical effects of anesthetics and requiring a separate course on anesthesia during medical education. He also described many of the modern methods of anesthesia, including inhaled endotracheal anesthesia, intravenous anesthetics, rectal use of anesthetics, and spinal anesthesia. In 1847, he was the first to use ether narcosis on wounded soldiers, and he performed approximately 100 operations on the battlefield during the war in the Caucasus. This had a major effect on the analgesia provided to wounded soldiers in terms of increasing surgical success and rates of survival. (R.D. Miller: Although wars cause an enormous harm to humanity, they have facilitated development of anesthetic techniques for patients undergoing trauma and other major surgical procedures, including Russia in the late 1800s.)

In 1904, the Russian physicians S.P. Feodorov and N.P. Kravkov described and demonstrated total intravascular anesthesia with the intravenous anesthetic gedonal. They were also the first to use combined narcosis through induction with gedonal and maintenance with inhaled chloroform.

Another area in which Russian physicians made advances was in the field of blood transfusions (see Chapter 61). In 1901, Karl Landsteiner reported his discovery of the possible existence of blood types. In 1909, he expanded his initial discovery by establishing the A, B, AB, and O blood types. He demonstrated that transfusions between individuals with the same blood group do not result in the destruction of new blood cells and that this catastrophe occurs only when a person is transfused with the blood of a person belonging to a different group. In 1930, Landsteiner received the Nobel Prize for his work. In 1907, Russian physician Yanskiy had also described four blood types and created the basics of blood transfusion. His work, however, went unnoticed.

Just a few short years later, World War I began, followed by the October Revolution in 1917, which destroyed the monarchy in Russia. Civil war, general poverty, and empowerment of the Communist Party in the early 1920s led to dramatic changes in Russia's political philosophy, economics, and technical and scientific progress, all of which affected the development of medicine. With Joseph Stalin coming to power in the 1920s, communication with other countries in Europe was terminated, exchange of information stopped, and Russian physicians had to continue treating their patients while developing the art of medicine separate from the knowledge and advances in the rest of the world. Likewise, Russian medical advances were not known to the rest of the world and were often reinvented elsewhere.

THE CROSS-POLLINATION PERIOD: 1920-1980

In the late 1970s, the editor (R.D. Miller) took a sabbatical in Holland, during which time he lectured at a local university hospital. Also in residence at the time was a young anesthesiologist from Ecuador. The two physicians became friends as they shared ideas about the practice of anesthesiology and its future. This rich exchange about their profession continues to this day. This was the beginning of this editor's understanding of the interesting

and varied approaches in different parts of the world to achieve the status of anesthesiology as it now stands.

This cross-cultural exchange, however, is no aberration. Over the approximately 60 years from the end of World War I through the early 1980s, anesthesiologists from around the world began to meet in a variety of forums facilitated by air travel and modern communications.

Physicians received training and education abroad. Lecturers from diverse nations spoke frequently outside their home country and brought in new ideas and techniques. Academic and research journals proliferated, as did international congresses and access to textbooks, thereby laying the groundwork for a common understanding of how to practice anesthesia.

BRAZIL (Maria Carmona)

The participation of some Brazilian physicians in World War II was an excellent opportunity to practice and learn more about this emerging specialty (another example of the advance of anesthesia in a military conflict). In 1948, the Brazilian Society of Anesthesiology (SBA) was founded, and since then the SBA and the Federal Council of Medicine have played important roles in defining anesthesia policy and guidelines in Brazil.

CHILE/SOUTH AMERICA (Guillermo Lema)

General Concepts

Geographic and economic diversity have characterized the development of South America. The continent is the site of the Andes (the longest continental mountain range in the world), five desert regions, and rain forests—all of which have given rise to countries with distinct features. This geographic diversity has isolated most of the countries and created huge natural frontiers.

The immigrant populations and the heritage of the native peoples have added their own characteristics. Development has been unique for most countries, resulting in enormous disparity. This disparity is present in numerous aspects of people's lives.

South America's economic growth has been influenced by foreign countries, their economic resources, and investment policies. Some have assumed that most countries would have developed at almost the same speed; however, this has not been the case.

Immigration has also played an important role. The European influence may have been one of the factors for better and faster development in some countries, possibly because of a higher standard of education, a strong will to overcome hard times in their own native countries, and good integration into the South American society. This has certainly been the case in medicine.

South American countries have had to overcome local structural and economic difficulties over the last 50 years, and this has had an obvious effect on daily life.

It is obvious that, because of an economic liberalism in several countries in South America, economic development and disparity throughout the countries has increased enormously, with a discernible effect on medicine, including anesthesia.

In general, economic growth leads to the availability of better and more expedient medical care; however, this is not the case in many South American countries. Although personal incomes have increased, access to medicine of good quality has not been achieved as expected, probably because of the increasing complexity and rising costs of medical care. Indeed, more patients claim that they are receiving good medical care, but according to government authorities at the National Health Services, most countries have not been able to reach the desired goals.

These general concepts should be borne in mind when consideration is given to anesthesia in this region.

Medicine

The main influences on the South American practice of medicine in general, and anesthesia and surgery in particular, come from Europe. For many years, and particularly during the first six decades of the twentieth century, many doctors were trained in different parts of Europe, including France, Germany, and Scandinavian countries. The European influence was as strong in medicine as it was in other aspects of daily life.

One example of Europe's influence was the widespread use of the Ombrédanne in South America (Fig. 2-8). This device, used to deliver ether anesthesia, was invented in France in 1908 by a surgeon named Dr. Louis Ombrédanne (1871-1956). It is believed that South America is likely the only continent where this equipment was clinically acceptable and used widely.

Of course, ether was not the only anesthetic used during this time. Cyclopropane was also used, although Chile had a dramatic experience with this gas that eventually caused it to be banned. In 1963 at the Manuel Arriarán Hospital in Santiago, a cyclopropane tank exploded in a pediatric operating room. Two small boys and four physicians—two of them anesthesiologists—died. This remains one of the worst anesthesia-related accidents

Figure 2-8. The Ombrédanne anesthesia delivery device.

ever to happen in the world. New standards, including the banning of cyclopropane, were imposed to avoid further accidents.

The European influence remained strong for many years. In the 1970s, the influence of North America started to grow and continues through today. The North American influence is evident in many countries such as Argentina, Brazil, Colombia, Chile, and Uruguay, which have advanced technology, monitoring devices, drugs, and associations with various institutions in North America. In other South American countries where cultural and economic growth are deficient, contact with more developed countries is still lacking.

Because Spanish is the predominant language on the continent, with the exception of Brazil, a language barrier affects the relationship between doctors and foreign institutions. English is considered a second language in only a few countries. As a result, doctors can communicate fluently in English in relatively few places, such as in their sharing of medical experiences, attendance of meetings, and access to medical and anesthesia journals.

English as a second language is essential to obtain access to full information and to stay updated. If one is not able to do this, then there is the likelihood of being left behind. Unfortunately, this is the current situation in many countries.

Even with the availability of medical information online, a foreign language such as English is needed and should be part of undergraduate or postgraduate medical education. There are many medical journals in Spanish, but anesthesiologists must understand that English is by far the most common language used in the medical field.

CHINA (Yuguang Huang)

In the early twentieth century, with the introduction of Western medicine into China, modern anesthesia began to be applied in clinics. At that time, anesthesia was implemented mainly by nurses or surgeons. Only a few Western professional anesthesiologists, such as Yueqing Ma from the Peking Union Medical College, could undertake clinical anesthesia in China.

After the foundation of the People's Republic of China in 1949, some early pioneers—such as Jue Wu and Xingfang Li from Shanghai and Rong Xie, Deyan Shang, and Huiying Tan from Beijing—returned from the United States and Europe to help modern anesthesia take shape in China.

In the 1950s, only simple anesthesia was available in China, such as the ether open-drop method, inhaled tracheal intubation anesthesia, and single procaine spinal anesthesia. Peripheral nerve block and continuous epidural anesthesia were introduced on a gradual basis. From the 1950s to the 1980s, intravenous procaine combined anesthesia and continuous epidural anesthesia were the most common methods in China. When anesthetic drugs and monitoring tools became scarce in the 1960s, Chinese anesthesiologists tried to develop acupuncture anesthesia based on the pain-relieving mechanisms of traditional Chinese acupuncture. In the 1970s, Chinese anesthesiologists investigated the anesthetic effect of Chinese herbal medicine. However, beginning in the late 1970s, because of the success of reform and the government's more open foreign policy, many new anesthetic drugs and instruments were introduced into China. At that time, acupuncture anesthesia and herbal anesthesia stepped down from the clinical stage because of their unsatisfying anesthetic efficacy and adverse effects.

Raising the Professional Profile of Anesthesia

Chinese anesthesiologists also began raising their profile as early as the 1950s, when they took part in the rescue of critically ill patients via cardiopulmonary resuscitation. For example, in 1959, Professor Yuanchang Wang from Tianjin Medical College shared his experience in the *Chinese Journal of Surgery* by reporting that a woman whose life was in danger during cesarean section was saved by chest compressions. Partly because of the influence of anesthesiologists, since the 1970s intensive care units (ICUs) and postanesthesia care units (PACUs) have gradually been established in many domestic hospitals.

China has also participated in numerous international conferences and professional groups (Fig. 2-9). The First National Conference on Anesthesia was held in Nanjing in 1964, during which the development and achievements of Chinese anesthesiology were systematically reviewed. In 1979, the Chinese Society of Anesthesiology (CSA) was founded during the Second National Conference on Anesthesiology held in Harbin. Professor Deyan Shang was elected as president of the first CSA committee. Since then, national CSA conferences have been held every 3 or 4 years.

During this period, there was also a foray into professional publications, most notably by Professor Jue Wu, the leader of Chinese anesthesia, who was the lead editor of *Clinical Anesthesiology* in 1954 and *Practical Anesthesiology* in 1976.

Western medicine introduced by the United States also helped to promote the development of modern medicine in China. A good example is Peking Union Medical College Hospital, which was founded by the Rockefeller Foundation in 1917. Even today, Peking Union Medical College Hospital is still regarded as an "ivory tower" of Chinese medicine. Some professors from Peking Union Medical College Hospital moved to Taiwan in 1949, and some of them changed their specialization from surgery to anesthesiology and became the early practitioners of anesthesiology there. They made important contributions to the foundation and development of modern anesthesiology in Taiwan.

INDIA (Deepak K. Tempe)

Until approximately 30 years ago, anesthetic equipment in Indian operating rooms often consisted solely of a simple anesthesia machine, a suction unit, and perhaps an electrocardiographic monitor. Even the oxygen supply was mainly via cylinders, with few hospitals having a centralized medical gas supply. The first medical pipeline system was installed in Vellore in 1954.

Today it is widely accepted that postoperative care is crucial for the success of surgery, but in previous days,

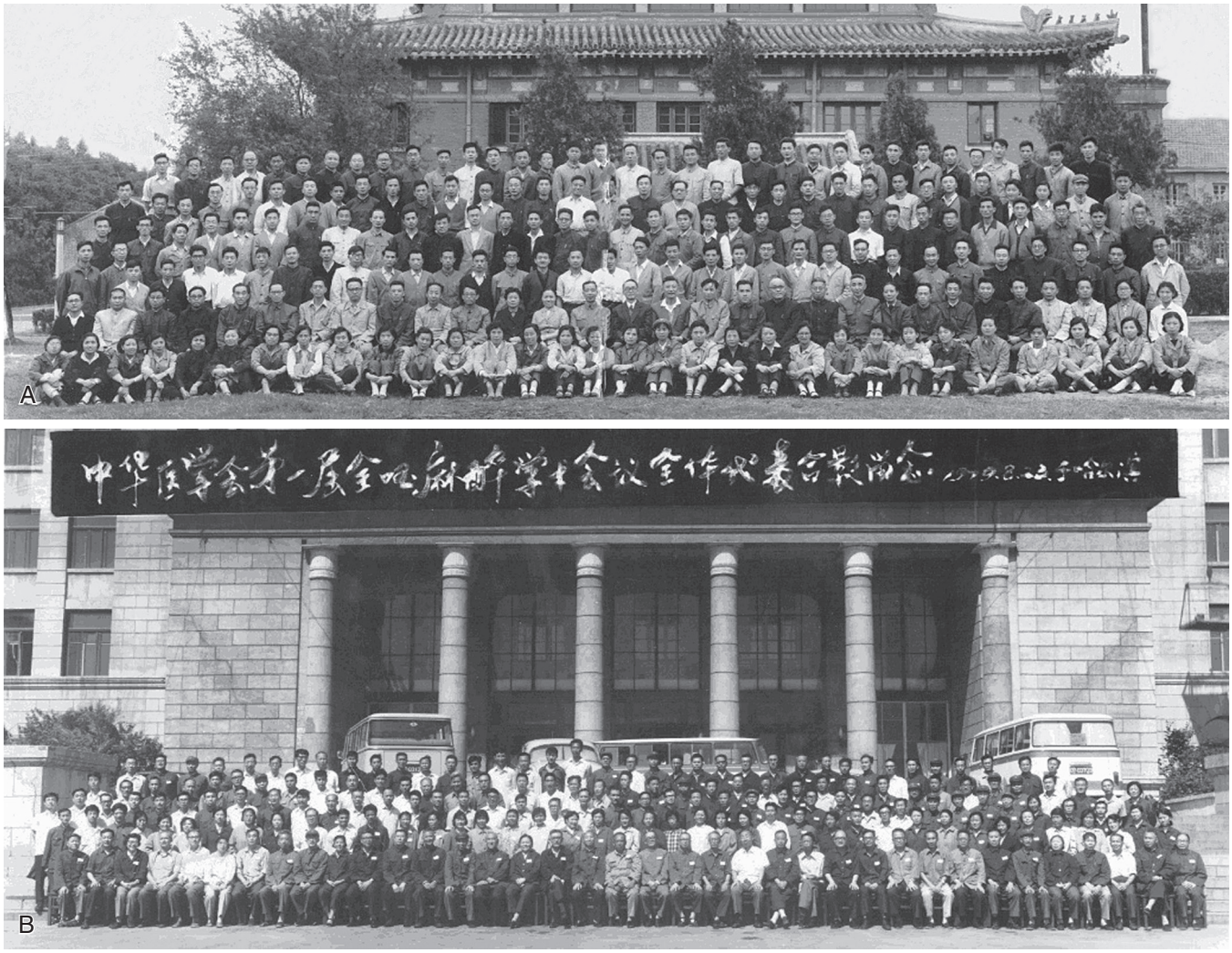


Figure 2-9. A, Participants of the First National Conference on Anesthesia, Nanjing, 1964. **B,** Participants of the Second National Conference on Anesthesia, Harbin, 1979, during which the Chinese Society of Anesthesiology was founded.

many patients were sent back to the ward directly after surgery and only a few would go to the recovery room. In recognition of the fact that surgical patients often need to be observed in a specialized area, India commissioned its first ICU in 1963 in an Army hospital in Delhi. Notably, that was the same year that an ICU was first established by an anesthesiologist at the University of California, San Francisco.

During this period of the twentieth century, Indian anesthesiologists also recognized the need for professional societies. The idea of the Indian Society of Anaesthesiologists (ISA) was conceived in 1946, and the group was formally established in 1947. The first ISA meeting was held in 1949 during a surgeons' conference in Mumbai, and the first independent ISA conference was held in Hyderabad in 1965. Professors Macintosh and Gray were the distinguished guests during the conference. The ISA published its first official journal in July 1953 and joined the World Federation of Societies of Anesthesiologists (WFSA) in 1956. The group has grown from 19 members when it began to nearly 18,500 members in 2012. The Diploma in Anesthesia (DA) was first started in 1946 in Mumbai University, and the postgraduate degree course (Master of Science in Anesthesia) was started in 1955 at Darbhanga Medical College, Bihar.

JAPAN (Naoyuki Hirata and Michiaki Yamakage)

In the early 1900s, the Japanese government began using primarily Western medicine rather than Eastern medicine, which had been used for a long time. The Japanese government invited many medical instructors from Germany (Prussia at that time) to teach in Japan, and medical students from Japan studied in Germany. In those days, German physicians promoted local anesthesia rather than general anesthesia. Therefore, surgeons in Japan focused on local anesthesia, whereas general anesthesia dramatically developed in the United States and the United Kingdom.

In 1950, Dr. Meyer Saklad came to Japan to participate in the Joint Meeting of American and Japanese Medical Educators. He presented novel information on anesthesiology, including general anesthesia, to Japanese surgeons. His lectures created shock waves among Japanese

surgery professors. Since his lecture, anesthesiology in Japan has become much more developed; a Department of Anesthesiology was established at Tokyo University in 1952, and the JSA was established in 1954.

THE MIDDLE EAST (Anis Baraka and Fouad Salim Haddad)

At the end of World War I, the Middle East was divided by Western powers into small countries that were placed under British and French mandate. The major pattern in the practice of anesthesia was complete dependence on foreign surgeons, who could administer anesthetics, and on local and foreign nurses or nonanesthesiologists and technicians, who administered ether or chloroform. This period also witnessed the foundation of faculties of medicine in some countries of the Middle East (Syria, Sudan, and Iraq).[17]

By the end of World War II, the beginning of oil production contributed to an improving economy, which meant more funds available for anesthesia machines, endotracheal tubes, and thiopental, all of which began to appear in many countries of the Middle East. An influx of newly trained surgeons increased the demand for qualified anesthesiologists, thus prompting anesthesia residencies. In addition, in response to a manpower shortage in many countries in the Middle East, nurse and technician training began as well, although this was gradually phased out as locally and internationally trained and certified anesthesiologists began arriving in many countries of the Middle East.

During the second half of the twentieth century, all countries of the Middle East were striving to attain state-of-the-art anesthesia. The World Health Organization (WHO) played a significant role in encouraging and sponsoring graduate physicians for training in anesthesia at the World Anesthesiology Training Center in Copenhagen.

Raising the Professional Profile of Anesthesia

As in many other places in the world, the status of anesthesia in the Middle East depends partly on the establishment of fully independent departments of anesthesia that have their own structure, staff, residency training, research, and certification by international academic institutions and that offer fellowships in cardiovascular, obstetric, and pediatric anesthesia, as well as pain management. To that end, certain landmark strides were taken during this period.

In 1966, the *Middle East Journal of Anesthesiology* was founded. Its main objectives are to act as a forum for education and exchange of opinions and to promote research and publication of Middle Eastern medicine and anesthesia. The journal is accepted for inclusion in the Index Medicus and MEDLARS system.

In addition, in the 1960s and 1970s, many Middle Eastern countries founded their own national societies of anesthesia, which promoted the practice and image of the specialty. In 1990, The Pan Arab Society of Anesthesia and Intensive Care was founded and became a member of the WFSA. Every 2 years, the Pan Arab Society holds The Pan Arab Congress of Anesthesia and Intensive Care in one of the member countries.

RUSSIA (Yury S. Polushin and Olga N. Afonin)

In the midst of the economic difficulties and political upheaval after the Russian civil war, medical services underwent dramatic reorganization and expansion, and some positive developments ensued, including campaigns against diseases and poor hygiene. Thousands of unpaid men and women underwent short courses in nursing. They then went all over the country to educate people and treat deadly diseases, often risking their own lives. This remarkable effort was rewarded in just a few years. Epidemics were stopped, and control of many diseases was established. This experience emphasized the importance of preventive measures, including vaccinations, and Soviet physicians began working on preventive medicine.

Meanwhile in Moscow, Dr. Vadim Yurevich was the first in the world to begin using citrate for blood conservation. His colleague Dr. Vladimir Shamov was the first to use cadaveric blood for transfusion in 1928, thus giving birth to a new field of medicine—transplantation.

The first Institute of Blood Transfusion, a scientific center for study and development of the science of blood and blood component use and storage, was formed in 1926 in Moscow by Professor A. A. Bogdanov. Physicians of the institute developed and published the first systematic approach to the treatment of shock, including traumatic, hypovolemic, and "burn related." Another dramatically important innovation by Russian physicians was the introduction of methods of diagnosis and treatment of electrolyte and acid-base imbalances with complex salt solutions, blood substitutes, and total parenteral nutrition solutions.

In 1924, S. S. Bryuchonenko and S. I. Chechulin constructed and used the first artificial heart machine in the world, the forerunner of what is now known as a cardiopulmonary bypass machine. Surgical procedures were becoming more complex and required more advanced methods of exposure of the abdominal and thoracic organs. The bellows of Dr. Henry Hickman was transformed into many different machines to provide artificial ventilation, including the famous iron lung at Harvard, used first in Boston in 1928.

In Moscow in 1936, the Laboratory of Resuscitation of the Academy of Medical Sciences of the U.S.S.R. began investigations on the dynamics of vital functions during the terminal period and methods for the resuscitation of the dying organism.[20] As the head of the laboratory, V.A. Negovsky was instrumental in the integration of resuscitation in practical health care.

In 1939, N.L. Gurvich and G.S. Yun'ev developed the physiologic basis and methods of indirect heart massage and electrical defibrillation. These methods were used successfully on patients requiring complicated cardiothoracic surgeries in Russia.

In the U.S.S.R., the first endotracheal anesthesia with muscle relaxants was given by M. Anichkov in 1947 at the Military Medical Academy in Leningrad. The book *Intratracheal Anesthesia in Thoracic Surgery,* by S. M. Grigoriev and M. N. Anichkov, chronicles this event. After its publication, doctors from different regions of the country started to apply this method clinically.

As all these developments grew into complex surgical procedures and as the use of neuromuscular blocking drugs spread, it became necessary in Russia to develop a new kind of subspecialty in medicine: anesthesiology. This would require extensive and detailed knowledge of many disciplines, including physiology, biochemistry, surgery, medicine, neurology, pharmacology, traditional anesthesia, and critical care.

The first Department of Anesthesiology in Russia was formed in 1958 at the Military Medical Academy in Leningrad. Within a year, a second Department of Anesthesiology was formed in the Department of Cardiothoracic Surgery in Moscow (now the Russian Medical Academy of Physicians Postgraduate Education); this is the same year that the current Department of Anesthesia was formed at the University of California–San Francisco. The first postgraduate courses for physicians to become anesthesiologists lasted 4 months. Later, more courses of anesthesiology were incorporated, requiring additional months of training and including the basics of intensive care.

The broad variety of topics covered and the complexity of the potential patient care issues meant that the new specialists needed more time to prepare properly for their careers. These careers were in demand as newly formed anesthesiology and intensive care departments required more anesthesiologists to teach and take care of patients.

In 1966, the Ministry of Health of the Soviet Union released the "Order of improvement of anesthesiologic and reanimatologic (intensive care) services in the country." This governmental act legalized anesthesiology and gave it the financial and administrative support required at that time for any significant changes to take place. Along with the legalization of anesthesiology came the definition of functions and organizational structure. Most hospitals deployed units of anesthesiology, whereas institutions and universities formed departments of anesthesiology. Since 1969, anesthesiology and intensive care have been merging into a single specialty called anesthesiology-reanimatology.

THE MODERN PERIOD: THE ESSENTIALS OF MODERN ANESTHESIA AROUND THE WORLD

The last 30 years has been an exciting period for anesthesia, largely because the ability to share clinical and research experience has made the practice safer and better than it ever has been.

Today, all anesthesiologists, no matter where they practice in the world, can gain access to the information necessary to deliver safe anesthesia. However, there are still places in the world that do not have access to the equipment or supplies needed to implement that knowledge. This section details the essentials: the roles and responsibilities, the facilities and equipment available, the education and accreditation, the professional societies, the research conducted by anesthesiologists around the world, and the safety and medicolegal initiatives that have developed in these countries.

ROLES AND RESPONSIBILITIES OF ANESTHESIA PROVIDERS

Brazil (Maria Carmona)

Currently, only physicians are allowed to administer anesthesia, and the care of simultaneous procedures is prohibited. In other words, anesthesia was given to only one patient at a time. The Resolution from the Federal Council of Medicine (CFM 1802/06) related to the use of anesthesia recommends routine preoperative evaluation, and it defines the minimal structures and required equipment to perform anesthesia safely and for adequate postoperative care.

An electrocardiogram, noninvasive blood pressure meter, and a pulse oximeter are the minimal monitors for any kind of anesthesia. End-tidal carbon dioxide ($ETCO_2$) monitoring should also be available for any patients undergoing assisted or mechanical ventilation.

Chile/South America (Guillermo Lema)

For the past 50 years, anesthesiologists have been involved in PACUs and more recently have been responsible for them, including determination of the standards of care for these areas. Pediatric and cardiovascular anesthesia is generally performed by physicians with subspecialty training in these areas. Pain management and critical care reflect important areas in which the influence of the anesthesiologist has been important. Anesthesia-trained personnel run most of these units.

Another area of interest is the choice that many physicians, including anesthesiologists, must make between public and private hospitals. Historically, anesthesiologists have worked in public hospitals. The development of private practices in small clinics and in other institutions attracted many practitioners, who then reduced their work in public hospitals to part-time in the mornings. Currently, anesthesiologists work solely in one hospital, either public or private, with strict professional duties and cost containment as a major responsibility.

Most of the private clinics are run by private economic groups that operate under stringent financial criteria. In these institutions, the activities of anesthesiologists and other specialists are restricted, and only a few colleagues dedicate their time to administrative duties.

Although the resources to public hospitals are increasing, the benefit of these resources is less than one might have expected, probably because of their centralized administration, which is not run by practitioners. Thus, economic restraints and inadequate conditions for anesthesiologists make positions in public practice unlikely to be filled completely, because private work is a more attractive option.

China (Yuguang Huang)

In the last decade, the overall professional level and social status of Chinese anesthesiologists have gained prominence, as has medical education in the field. Each year, large numbers of outstanding medical graduates enter the anesthesiology resident training program, adding greatly to the activities of existing teams. Accompanying the country's economic prosperity are developments in the medical field that put China on par with developed

countries in terms of routinely prescribed drugs and commonly used sophisticated monitoring equipment. The development of anesthesiology has also encouraged the continuing growth of other surgical departments.

The specialty of anesthesiology in China is mainly composed of clinical anesthesia, pain management, emergency resuscitation, and extracorporeal circulation. The scope and versatility of clinical anesthesia have greatly expanded. For example, Chinese anesthesiologists can now receive training for transesophageal echocardiography (TEE) examinations through continuing medical education lectures at large hospitals, with the more outstanding ones having obtained the senior certification for TEE from the United States and Hong Kong. These clinicians are capable of performing intraoperative ultrasound examinations independent of assistance from ultrasound physicians. Therefore, the nation's objective is to train Chinese anesthesiologists so that they have multidisciplinary talents within the near future. Aside from clinical practice in the operating theaters, anesthesiologists are also becoming involved in such clinical diagnostic and therapeutic procedures as endoscopy, fetus reduction at the fertility center, and provision of comfortable alternative solutions to patients undergoing mini-invasive procedures outside the operating theater. Anesthesiologists are earning more respect and recognition from physicians of other specialties and patients in China.

Anesthesiology has also evolved to be the perioperative medicine in multiple aspects. Patient blood management and perioperative blood conservation techniques are an internationally acknowledged issue. Over the years, the Chinese Ministry of Health (MOH), which in 2013 was integrated into a new agency called the National Health and Family Planning Commission, has invested tens of millions of dollars to support the study and improvement of clinical rational blood use, in which anesthesiologists have played a crucial role in education and team leadership. MOH is the leading unit and pilot center for this project, and the Anesthesiology Department of the Peking Union Medical College Hospital has made great contributions to the project through collaborations with other medical centers in Wuhan, Shanghai, Chengdu, and Zhejiang.

Currently, national guideline and blood management standards have been adopted in a majority of provinces, greatly alleviating the pressures exerted by limited blood supply and avoiding transfusion-related complications to a large extent. In addition, a number of hospitals have pain clinics providing good pain management for in-hospital patients. Anesthesiology has evolved as a crucial medical specialty that enjoys rising status in general hospitals, with department chiefs being involved in the leadership of hospital management.

In addition, anesthesiologists have become integral to multidisciplinary collaborations, reflecting the growing status and recognition of anesthesiologists by their peers. Primary trauma care, a program promoted globally by the WHO, focuses on increasing awareness, and enabling and promoting training of medical practitioners in trauma management. MOH has designated the project as a high priority and assigned the Chinese Association of Anesthesiologists and Chinese Association of Emergency Physicians to oversee its responsible implementation. In the past 2.5 years, 4847 doctors and nurses in 1927 hospitals from 15 provinces have been trained with primary trauma care throughout China, resulting in an improvement in the level of primary trauma care in China. This project has received great acclaim and recognition from physicians and local hospital leaders, reflecting the execution skills, unified collaboration, and leadership capabilities of Chinese anesthesiologists.

Europe (Lars I. Eriksson and Jannicke Mellin-Olsen)

The main activities in European anesthesia departments are to provide operating room anesthesia, postoperative care, critical care medicine, pain medicine, and critical emergency medicine.

The concept of anesthesiologists as perioperative physicians is a hallmark and well developed in many European countries. A considerable proportion of health care leaders are anesthesiologists who have a good overview of hospitals in general. In addition, in recent years anesthesiologists have taken more responsibility in leading patient safety initiatives.

In some countries, such as the Czech Republic, Germany, Italy, Moldova, Norway, and the United Kingdom, more than 30% of the activity of anesthesiologists is devoted to critical care medicine. Even in those countries where critical care is recognized as a separate primary specialty, as in Spain and Switzerland, anesthesiologists are involved in the care of the critically ill. Some physician groups want to introduce more specialties on a European level, such as in critical care medicine. Thus far, anesthesiologists have opposed such initiatives as counterproductive and assert that it is more desirable to define and develop competencies and particular qualifications to develop critical care medicine further. Emergency medicine is currently a separate specialty in Europe, but anesthesiologists regard critical emergency medicine a part of the professional domain. Anesthesiologists are involved, not least in the prehospital phase. In some countries, a large proportion of anesthesiologists are also active in acute and chronic pain medicine.[19]

In most of Europe, unlike in the United States, anesthesia can be delivered only by an anesthesiologist. In most European countries, nurses are involved, but with varying tasks and responsibilities. In general, there are two models of anesthesia nurses who participate in care. One model is the nurse anesthetist who is allowed to provide anesthesia without the presence of the in-charge physician in the room. Nurse anesthetists generally have a nursing degree with an additional 1 to 4 years of training, resulting in a diploma that entitles the nurse to administer anesthesia according to a plan defined by the anesthesiologist, including medication administration, tracheal intubation, and monitoring, depending on local protocol and terms and conditions of service. Countries where anesthesiologists work with nurse anesthetists are Scandinavia, the Netherlands, France, the Slovak Republic, and Bulgaria. The other model is the circulation nurse or anesthesia nurse, who can assist anesthesiologists during procedures but are not allowed to perform any direct patient-related roles beyond basic nursing tasks, such as preparing medication and administering intravenous fluid. In Ireland and Malta, even this model is not

allowed, in contrast to Finland, Germany, Italy, Romania, United Kingdom, and other countries.[21]

India (Deepak K. Tempe)

The current Indian government expenditure on health is 1% of gross domestic product (GDP). This amount will increase to 1.5% during the next 5-year plan (2012-2017).[22] This public spending on health as a proportion of GDP is far too small as compared with the expenditure in the United States and Europe (6% to 7%). In India, anesthesia can be administered by a qualified anesthesiologist or by a trainee anesthesiologist under the supervision of a qualified anesthesiologist. In some states, such as Delhi, a directive from the government has been issued that states, "Anesthesia must be administered by a qualified anesthesiologist, that is, an anesthesiologist with a postgraduate qualification and who has been actively working."

The duties and responsibilities of anesthesiologists have been evolving, but they have not yet been clearly defined by the ISA or Ministry of Health officials. Nevertheless, it is now well recognized that an anesthesiologist's work is not limited to the operating room. Typically, anesthesiologists in India are involved in the following types of care: (1) preoperative assessment and preparation of patients; (2) perioperative care of patients; (3) pain relief during the perioperative period; (4) management of critically ill patients; (5) management of acute, chronic, and cancer-related pain; (6) management and teaching of resuscitation skills; (7) provision of outpatient anesthesia services; (8) administrative involvement in establishing and managing health care organizations; (9) disaster management coordinator in the hospital; and (10) teaching and training of the medical and paramedical staff.

In addition to the duties just listed, both natural and manmade disasters have provided an extra challenge for anesthesiologists. By virtue of their ability to administer emergency life support measures, as well as their perioperative management skills, anesthesiologists were at the forefront during the 2001 Gujrat earthquake and tsunami disasters, and they actively participated in establishing operating theaters on site and providing care to victims. Likewise, during the 2011 Mumbai and Delhi bomb blasts, anesthesiologists played a leading role in performing emergency surgery and perioperative management.

Preoperative Evaluation. Preoperative evaluation and preparation of the patient are integral components of safe surgery; however, no dedicated preoperative anesthesia clinics (PACs) existed in India until the early 1980s, and currently almost all hospitals have a dedicated PAC that screens patients before surgery (including outpatient day surgery). In some government hospitals, the PAC is located in the main outpatient department block, signifying that it is an integral part of this department. PACs have become increasingly important because of the growing incidence of cardiovascular and other systemic diseases in patients undergoing surgery. In PACs, anesthesiologists review and optimize the treatment of other systemic diseases and detect new diseases and health concerns. PACs have improved patient outcomes, and they are credited with facilitating the patient-physician relationship and discussions on patient awareness of anesthesia. A few hospitals have started awareness programs wherein a lecture is delivered (with illustrations) on a monthly basis to patients and their relatives to familiarize them with the anesthetic techniques and procedures that they will undergo.

Operating Room. The operating room continues to be the mainstay of anesthetic practice, where the anesthesiologist fulfills his primary responsibility of providing safe anesthesia to patients undergoing surgery. Operating rooms are major consumers of hospital resources and major sources of income for private hospitals; therefore, it is imperative that they be managed in the most efficient manner. However, there is no consensus on an ideal system to ensure efficiency in this area. The anesthesiologist is actively involved in trying to improve efficiency, especially with triage and the scheduling of urgent and emergency cases. In addition, the anesthesiologist is responsible for designing and equipping the operating rooms.[23] Safety is another concern. The professional risks (especially those related to needlestick injuries) of anesthesiologists, as well as other operating room staff, are well recognized, and preventing such health care hazards has become an important consideration.

Recovery Room and Postoperative Intensive Care Units. Appropriate postoperative care is crucial for the success of surgery. Today in India, depending on the nature of the surgery and the patient's condition, the patient is transferred to a recovery room or an ICU. Some version of an ICU or recovery room exists in almost all major hospitals in India today. The nomenclature used to describe these areas is not uniform. As a result, terms such as *postoperative ward, recovery room, high-dependence unit, critical care unit,* and *PACU* are often used to describe the same facility. At some hospitals, especially those in which major and complex surgery requiring postoperative ICU management is not performed regularly, there is no demarcation between an ICU and the recovery room. A single area designated as a recovery room is used for both purposes.

Where there is a distinction, the decision about where a postsurgical patient belongs is governed by the degree of morbidity. If a patient is very sick and requires ventilation and careful hemodynamic monitoring, the patient is transferred to an ICU. If mechanical ventilation and continuous hemodynamic monitoring are not required, the patient is transferred to a recovery room, which is perhaps the equivalent of the PACU. Patients undergoing day surgery (if practiced in a given hospital) are also transferred to the recovery room before discharge.

Most recovery rooms are under the charge of an anesthesiologist; in the case of ICUs, sometimes the anesthesiologist is in charge. Practice varies by location, and it is generally governed more by the logistics involved in a particular hospital than by any definite norms.

Ambulatory Care and Other Areas. Although it is recognized and appreciated that ambulatory care is a distinct possibility in a substantial number of patients, it

is not practiced as much as it should be. It is difficult to provide exact figures in this matter, but in general, the private (corporate) hospitals provide ambulatory care. The number of government hospitals practicing ambulatory care is relatively small, mainly because of logistic reasons. However, that is likely to change with the increasing availability of short-duration anesthetic drugs and modern surgical facilities (tools for minimally invasive surgery). Saving costs to the patient and the hospital and increasing patient turnover have been the major factors influencing interest in ambulatory care. The safety issues related to ambulatory care are well recognized, but there are no guidelines or recommendations from the ISA or any other regulatory body on this matter.

Anesthesia services are also frequently required in several other areas within the hospital but outside the operating room. These areas tend to be less familiar to most anesthesiologists and provide less access to the facilities typically available in an operating room. Their proliferation, however, has increased the demands on the field of anesthesiology. Areas where anesthesia is playing an increasingly prominent role include radiology suites (computed tomography, magnetic resonance imaging [MRI], and interventional radiology), the cardiac catheterization laboratory, electrophysiologic laboratories, the endoscopy room, and the electroconvulsive therapy room. In most of these areas, patients require sedation, but with some lengthy procedures—such as MRI, electrophysiologic studies, and some interventional procedures—patients tend to get restless and may require general anesthesia. In addition, special considerations such as long breathing circuits or MRI-compatible equipment may be necessary. The anesthesiologist should be familiar with these requirements to maintain safety standards. There is a tendency to consider these procedures as minor (by our clinical counterparts), thus undermining the safety requirements. However, the anesthesiologist must ensure that adequate safety standards are maintained in all these areas.

Critical Care Medicine. In the beginning, the anesthesiologist's focus on critically ill patients was ventilatory care because anesthesiologists are well versed in cardiorespiratory physiology and ventilatory management. Furthermore, managing a critically ill patient was considered an extension of the job that anesthesiologists performed in the operating room. Therefore, the anesthesiologist managed patients receiving controlled ventilation via a ventilator and, ultimately, weaned patients from mechanical ventilation.

Subsequently, however, it became obvious that respiratory function was only one aspect (albeit a crucial one) of the care of the critically ill. Anesthesiologists then became well informed about cardiovascular support, nutrition, infection, and various other diagnostic procedures. However, the interest of anesthesiologists in critical care medicine has vacillated, and other specialists have entered this field. Currently, management of critical care units in India tends to be split: some are managed by physicians not trained in anesthesia, others by anesthesiologists.

There is widespread agreement that a critical care specialist who is devoted full-time to the care of critically ill patients should manage a critical care unit. The consensus includes three key items: (1) a dedicated expert irrespective of the specialty (if not holding a critical care qualification) should be in charge of the critical care unit; (2) each hospital can follow practices according to the availability of trained or experienced personnel with the primary aim of giving the best possible care; and (3) care of critically ill patients is always a team-based process, and the practice of taking the advice of different experts in managing a particular case is encouraged to achieve better outcomes.

Critical care training has long been part of the anesthesia residency program in India, but in 2001 the National Board of Examinations initiated a full-fledged 2-year training program in critical care medicine with six seats throughout India; the number has now increased to 40. Anesthesiologists, chest physicians, and general physicians are eligible to seek admission to this program. Clearly, the number of these specialized intensivists is not sufficient to cater to the critical care units that have mushroomed all over India. In an attempt to increase the number of critical care specialists in the country, the Indian Society of Critical Care Medicine has initiated a 1-year diploma course (335 total seats), and 1-year fellowship course after obtaining the diploma (66 total seats).[24] Although these courses are not recognized, they have helped to increase the number of critical care specialists in the country. Anesthesiologists account for approximately half of the training seats, followed by general physicians (30%) and chest physicians (20%). The fact that all the seats in this program are filled suggests the growing interest in this specialty area. The Medical Council of India has recognized critical care medicine as a separate subject vide by way of amendment notification dated December 8, 2010. Thus, it will not be long before medical colleges start postdoctoral courses (DM and others) in critical care medicine.

In summary, critical care medicine has emerged as a new specialty that is still evolving in India. Because the number of people with a qualification in the critical care area is not sufficient to fill current needs, anesthesiologists and physicians with an interest in the specialty continue to practice critical care medicine. Such an arrangement is likely to continue until a sufficient number of qualified critical care specialists are available in the country. Going by the current number of seats available in critical care training programs, this transition period is likely to be rather prolonged. The author believes that once the transition period is over, critical care units will be manned full time only by qualified critical care personnel so that the anesthesiologist–turned–critical care expert will not practice anesthesia and a physician–turned–critical care expert will not practice medicine. Anesthesiologists will be more focused on postoperative care, which will include pain relief and short-term ventilation.

One problem that has emerged in India is the indiscriminate use of antibiotics, leading to the emergence of resistant bacterial strains.[25] The emergence of New Delhi metallo-B-lactamase-1 (NDM-1) and its prevalence in India was highlighted recently.[26] There is thus

a potential for wider international spread of plasmids encoding NDM-1. A coordinated, concentrated, and collective effort from clinicians worldwide is needed to prevent the emergence of resistant strains and their spread.[27]

Pain Management. Over the last 30 years, there has been a growing interest in managing acute and chronic pain. Yet the specialty is in its infancy in India, the number of pain clinics is limited, and there is no formal training program. According to one estimate, only about 10% of medical colleges in the country have pain clinics, so aspiring pain management professionals will almost always have to train abroad.[28] Some private corporate hospitals have now incorporated this facility. The focus has largely been on the treatment of chronic pain, including cancer pain. Most anesthesiology departments perform nerve blocks, with a few even practicing acupuncture. There are, however, few departments that have the facilities to conduct procedures such as radiofrequency ablation, implantation of intrathecal pumps, or spinal cord stimulation. The thrust now is toward treating pain as a disease, especially in patients suffering from nervous disorders or in terminal cancer patients, for whom the only possible form of management is alleviation of pain.

There is also growing awareness of the management of acute pain, including the possibility of providing the patient with a totally pain-free surgical experience. After all, the WHO now recognizes pain as the fifth vital sign, and alleviation of pain is regarded as a basic human right. Various forms of medicine and equipment (patient-controlled analgesia pumps, intrathecal, epidural, and intrapleural techniques) can now offer the possibility of a relatively pain-free course of surgical treatment. Indeed, management of acute pain during the entire perioperative period is a leading concern of all anesthesia departments, and it is actively practiced in recovery rooms or PACUs. Still, much remains needs to be done regarding pain management in India.

The Indian Society for the Study of Pain was formed in 1984 and currently has more than 1300 members from almost 25 different specialties.[29] The society is working toward improving pain management, but it is facing tough challenges, mainly because of lack of awareness. Most medical professionals tell most patients to live with pain, and patients tend to believe that pain is simply an expected part of the suffering caused by their disease. In addition, many doctors believe that referring a patient to a pain management expert would essentially be a statement of their medical shortcomings—and if the pain is relieved, the patient may never come back.[28] This author looks forward to improving pain relief facilities in the country.

Japan (Naoyuki Hirata and Michiaki Yamakage)

Anesthesiologists in Japan work in operating rooms, emergency departments, ICUs, pain clinics, and palliative units. The JSA recommends that perioperative management be provided by experienced anesthesiologists or residents supervised by certified anesthesiologists. Based on a survey of the JSA membership in 2005, over 90% of surgical anesthesia was provided by anesthesiologists or supervised residents at university hospitals. On the other hand, about 10% of surgical anesthesia was still performed by surgeons at nonuniversity hospitals. In Japan, there is no educational program for nurse anesthetists. The JSA survey also showed that the ratio of daily time spent by anesthesiologists on perioperative management was 60% to 70%, with 10% in ICUs, 13% in emergency departments, 30% in education and research work at university hospitals, and 12% in education and research work at nonuniversity hospitals.

Middle East (Anis Baraka and Fouad Salim Haddad)

In the Middle East, anesthesia is routinely administered by a qualified anesthesiologist. Trainee anesthesiologist or anesthesia nurses can administer anesthesia under the supervision of a qualified anesthesiologist. In addition, the departments and societies of anesthesiology in the different countries of the Middle East are responsible for setting the guidelines for sedation and analgesia by doctors who are not anesthesiologists.

The responsibilities of the anesthesiologist have evolved to include preoperative assessment, premedication, and preparation of patients, as well as postoperative anesthesia care in the PACU, which functions for 24 hours, as well as in the ICU. A preoperative informed consent for anesthesia must be completed by the anesthesiologist and signed by the patient, the guardian, or his or her legal representative.

Anesthesia administration is not limited to the operating room, but includes other areas such as the radiology department, ambulatory anesthesia, and obstetric anesthesia in the delivery suite. In addition, pain management, whether acute postoperative pain management or chronic pain management, is becoming routinely practiced and is evolving as a subspecialty of anesthesia. Subspecialization by a fellowship program is expanding to cover many areas such as obstetric, cardiopulmonary, and pediatric anesthesia, as well as critical care and pain management.

Russia (Yury S. Polushin and Olga N. Afonin)

Until the 1980s, Russia's anesthesia educational system was unified and structured into courses for nurse anesthetists and postgraduate education for physicians that included either a 1-year anesthesiology internship or a 2-year "Orditatura" (analogue of residency). All the programs included intensive care (reanimatology) as an obligatory part of the education. Participants were working in operating rooms and ICUs under the supervision of attending physicians and had a required course of lectures. Self-education was encouraged as well. After completion of training, graduates had to pass an oral qualification examination and were granted a Diploma of a Physician Anesthesiologist-Reanimatologist.

The quality of the education and the amount of experience varied significantly from program to program, and there were no universally accepted standardized examinations. Many conscientious anesthesiologists took additional courses on "qualification improvements" from the

Academy of Physicians Postgraduate Education. However, there were also "specialists" whose education was finalized on completion of the courses.

By the end of the 1980s, it became clear that the quality of education had to be monitored; debate led to the acceptance of standardized examinations. Meanwhile, the Iron Curtain had become partially permeable to some of the information about accepted standards of education and care in the other countries. The future promised improvements, but not for long. The "era of stagnation" of the 1980s led to economic imbalance and a gradual decline in political structures. By the end of the 1980s, Communist leaders embarked on major reforms in an effort to revive the country's economics, which led to the collapse of the Soviet Union.

Consequently, government financial support for the entire medical structure was reduced and eventually disappeared. All financially unsound programs, such as research, education, and the development of new technologies or educational methods, were frozen. The government-funded health care system no longer existed. Many professionals had to quit their careers for their families to survive. The private sector was in the very beginning of its development, and the majority of the population could not afford private health care. It was not uncommon for patients to be asked to bring supplies for the medical care that they required, even for surgeries, and it was not uncommon for people to die because of the lack of proper medications or proper medical care. This continued until the mid-1990s, when things began to turn around. The damage, however, has not been completely overcome, even now.

Southeast Asia (Florian R. Nuevo)

The political, geographic Association of Southeast Asian Nations (also known as ASEAN) includes Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. During the past 5 years, the role of physician anesthesiologists in this region has changed remarkably. Physician anesthesiologists have gained recognition by peers and the populace, undeniably maintaining a strong respectable presence in the operating suites and ambulatory centers. Apart from this role, the physician anesthesiologists who have undergone subspecialization are now recognized as coequals by their colleagues in the realm of pain management and intensive care.

Tangible evidence of the fortified role of ASEAN physician anesthesiologists in pain management is the Association of Southeast Asian Pain Societies (ASEAPS), formed in 2004 with the goal of further advancing the study of pain in the region. As a result, there are more academic pain management fellowships in the region. This specialized body has inspired anesthesiologists and other pain specialists to work together and develop practical, cost-effective, and rational approaches in addressing the continuing concerns of acute surgical pain, cancer pain, and chronic nonmalignant pain problems, particularly in resource-challenged work environments. Their unified objectives paved the way for governments to join in the advocacy of adequate pain control, particularly among cancer patients. Hospice care and palliative medicine are also areas in which anesthesiologists are now team leaders.

Another recent development is the increased interest among newly qualified physician anesthesiologists to become intensivists with special focus in areas such as pediatric intensive care, cardiothoracic intensive care, neurosurgical intensive care, and surgical intensive care. This development has broadened leadership in ICUs to include anesthesiologists, which had been dominated by specialists such as cardiologists, pulmonologists, and surgeons.

Specific mention must also go to the increased presence of the Asian Society of Cardiothoracic Anesthesia (ASCA). The ASCA serves as the unifying body for Asian cardiac anesthesiologists and envisions itself as the focal organization to address the evolving responsibilities of cardiac anesthesiologists on the utility of intraoperative TEE monitoring. This is now at a critical phase that is challenging the ASEAN cardiac anesthesiologists who must, for the moment, continue to share the stage with cardiologists inside the operating rooms.

Through ASCA, efforts to develop proficiency on TEE as an essential monitoring tool have instigated collaborations and strengthened cooperation between cardiologists, surgeons, and cardiac anesthesiologists. The Japanese Society of Cardiovascular Anesthesiologists has pioneered the proficiency on TEE and its Japanese Board of Perioperative Transesophageal Echocardiography has gained recognition by accreditation commissions in the United States and Europe. In the last 5 years, ASCA has offered basic TEE workshops for noncardiac anesthesiologists in many anesthesia conferences. Today, ASCA plans to offer more intermediate TEE workshops and introduce master TEE workshops for cardiac anesthesiologists in the region. It is hoped that in the next 5 years, ASEAN cardiac anesthesiologists will be duly given an independent role, similar to the current situation of cardiac anesthesiologists in Japan, China, Korea, and Taiwan.

With the introduction of ultrasound machines into the region, the application of regional blocks in orthopedic surgery has soared because of the increased demand from surgeons. This evolvement has contributed to better pain management in orthopedic surgery patients.

Among ASEAN anesthesiologists, the overall mood is optimistic and forward thinking. As ASEAN anesthesiologists succeed in their new roles that are outside the traditional anesthetist role in delivery rooms and operating suites, they must remember their primary responsibilities as anesthesia care providers while also recognizing the need to continue to evolve in order to become truly competent perioperative physicians.

Nurse anesthesia practitioners in the region do not yet have full autonomy. They are part of the perioperative anesthesia care team and are supervised as appropriate by physician anesthesiologists (Table 2-1). Nurse anesthesia practitioners are legally allowed only in Thailand, Indonesia, and Taiwan. In these countries, physicians design and conduct their respective nurse anesthesia training programs. However, in the Philippines, Singapore, and Malaysia, these societies maintain that anesthesia is a practice of medicine by qualified medical doctors.

TABLE 2-1 **WORKFORCE, SCOPE, AND TYPE OF PRACTICE IN SOUTHEAST ASIAN COUNTRIES**

	Indonesia	Malaysia	Philippines	Singapore	Thailand
Workforce					
Physician anesthesiologists	Yes	Yes	Yes	Yes	Yes
Nurse anesthetists	Yes	No	No	No	Yes
Anesthesia Scope of Practice					
Anesthetizing locations	Yes	Yes	Yes	Yes	Yes
Pain management	Yes	Yes	Yes	Yes	Yes
Intensive care	Yes	Yes	Yes	Yes	Yes
Type of Practice					
Physician and nurse anesthetists	Nurse anesthetists trained and supervised by physician anesthetists		Group practice slowly gaining support		Nurse anesthetists trained and supervised by physician anesthetists

With professional pride, ASEAN anesthesiologists have emerged as capable leaders in their respective national medical organizations, and they are driven with passionate social advocacies to help society and to partner with their government agencies to improve the delivery of medical and surgical care. It is no longer unusual for physician anesthesiologists to be designated as quality management officers or as medical directors.

FACILITIES AND EQUIPMENT

Brazil (Maria Carmona)

Brazil is the fifth largest country in the world in terms of area and the fifth most populous with approximately 200 million inhabitants. Although the Brazilian constitution declares health care to be the right of every citizen and its provision to be a duty of the state, there is a substantial gap between the aspirations of Brazil's Unified System of Health and reality. Total expenditure on health in Brazil is only 8.4% of gross national product, which is half the amount invested by the United States. In addition, almost half of all health care costs in Brazil are met by private health care. Consequently, both the provision of anesthesia and the entire health care system itself present a great heterogeneity in quality and service throughout the country, and this is closely related to the economic development of different regions. Apart from the excellent anesthesia care available in some government and private hospitals in a few cities, the majority of the poor population in urban and rural areas do not receive good quality care, regardless of whether the financing is public or private. On the other hand, the dynamics between private and public health sectors is constantly changing with continuous pressure on both to expand delivery. However, the bureaucracy of the public system and the apparently superior performance of private health care sometimes involve the transfer of public funds to the private sector, followed by reductions in public sector service budgets and staff availability. These public–private partnerships and the increasing number of people buying into private services are moving the Brazilian health care system through a slow, passive privatization.

Brazil's aging population is increasing faster than ever before, and it has the sixth largest population of older adults in the world. Although longevity is a significant measure of social well-being, it is a challenge for public health care and increases the complexity of anesthesia care.

Considering obstetrics care, although the WHO guidelines state that the proportion of cesarean births should range between 5% and 15%, the incidence of cesarean sections in Brazil is approximately 50%—one of the highest worldwide. The higher rates of cesarean section are observed both in private and public hospitals, and spinal anesthesia is the most frequent technique for this surgery.

Regional anesthesia is popular in Brazil because of its many advantages, such as a smooth recovery, maintenance of the patient's own airway, low risk of aspiration of gastric contents, and less need for skilled nursing care than with general anesthesia. Brazilian anesthesiologists are highly skilled in different regional anesthesia techniques.

Most of the equipment and drugs used in anesthesia are produced in Brazil. The country has several equipment manufacturers who are trying to develop products that match the best in the world. They provide products to the domestic market and export to a number of Latin American and African countries. Moreover, the world's most important manufacturers of equipment and pharmaceutical companies also manufacture or market their products in Brazil. To improve the population's access to health care, incentives have been offered for marketing generic drugs at a lower cost than brand name products.

Chile/South America (Guillermo Lema)

The huge disparity in economic growth among countries in the region has produced an enormous difference in public resources allocated to health care and created different conditions for public health management. Governments view anesthesiology as a low priority because, in their view, it has not had a significant effect on the improvement of health care, and the technology involved is costly.

The current status of the practice of anesthesia is being replicated by all countries in South America with most

at different stages of the process. Some countries have standards of care comparable to American or European countries, whereas others are only beginning to have anesthesia as a mature specialty. Countries such as Argentina, Brazil, Colombia, Chile, and Uruguay are in the mature phase and have modern equipment, advanced monitoring technology, and access to a variety of anesthetics and ancillary drugs.

Anesthesia techniques vary, and many different types are being practiced. Anesthesia with halogenated drugs has been used widely, for many years, and in all countries. Total intravenous anesthesia is now common, especially with younger colleagues. The use of regional anesthesia has been widespread in all countries, and each country has its own training programs and congresses.

Although some countries have modern equipment, monitors, and drugs comparable to the United States or Europe, others have very basic systems to perform anesthesia appropriately; therefore, cost containment has been a critical aspect in clinical practice. Indeed, this situation is common globally. This disparity in medical resources among countries has been reduced because of trade with different countries, such as China, India, Brazil, and some European countries. Prices of products from these countries are much lower than from North American companies.

China (Yuguang Huang)

China's rapid economic growth has been accompanied by the acquisition of updated anesthetic equipment and apparatus. Except for a few distant rural areas and smaller provincial hospitals, the ratio of anesthetic machines, multifunction monitors, and expirium gas monitors in the operating theaters has reached a 1-to-1 capacity. National-level hospitals in more developed areas are equipped with international-class modern anesthetic machines and a variety of monitors, including neuromuscular monitors, anesthesia depth-monitoring devices, coagulation function test equipment, three-dimensional TEE or portable ultrasound equipment, neurostimulation devices, and pulse index continuous cardiac output hemodynamic monitors. Even MRI-compatible anesthesia machines are available in some large hospitals. By using current equipment and devices, medical practitioners and their facilities are providing better patient care and safety. Upgraded utensils on difficult airway carts and workshops on various airway techniques (e.g., visual digital laryngoscope, laryngeal mask) have helped China to realize great improvements in airway management.

However, an imbalance in economic development across massive mainland China has resulted in a corresponding imbalance in the sophistication and quantity of anesthesia devices. Currently, primary-level hospitals lack sufficient modern anesthesia equipment. Local investigations indicate that in second-level hospitals, the ratio of anesthetic machines to operating theaters is 0.7-0.8 to 1, whereas the ratio in national-level hospitals is 0.5 to 1. Thus, safety in clinical anesthesia faces major challenges. To resolve the existing problems, MOH approved the *Anaesthesiology Standard Regulatory Protocol* in 2012, which established national standards for all hospitals. These standards address facility and personnel qualifications and determine the minimum standards and facility requirements for clinical anesthesiology safety. The expectation is that the protocol will bring about changes to the current status in remote and rural areas.

Europe (Lars I. Eriksson and Jannicke Mellin-Olsen)

The WHO lists 53 countries in their Regional Section of Europe, reflecting diversity from Scandinavia and Germany to Georgia and Uzbekistan. The European Union (EU) has 28 member countries, and an additional nine have applied to become members, most of them from Eastern Europe.

Despite their political and economic partnership in the EU, the countries of Europe remain heterogeneous, which is reflected in the prevailing diversity of medical systems, research, and education, as well as in language and culture.

India (Deepak K. Tempe)

In India, the journey from open-drop chloroform and ether anesthesia to the present day high-tech operating rooms with anesthesia workstations and monitors, ICUs, PACUs, pain clinics, and preanesthetic checkup clinics is nearly complete. In fact, the operating rooms in India have undergone significant change during the last 20 to 30 years. The present-day operating room is modular in structure with high-tech anesthesia workstations, monitoring systems, and on-line networking. Such a change has been largely due to the arrival of private investment and management in the health care business. These corporate hospitals have built state-of-the-art operating rooms that match the best operating rooms in the rest of the world.

However, it is necessary to keep in mind that like many other things in India, diversity is also a hallmark of the health care system—that is, the assortment of medical facilities and level of available services vary considerably. Although corporate and other private hospitals have state-of-the-art operating rooms, government hospitals—other than those in cities such as Delhi and Mumbai—may not. In general, government hospitals cater to the general population, are overcrowded, and have long waiting lists. The situation in rural areas in particular is not up to the benchmark because these places typically have only primary health centers with basic facilities, and the operating rooms are equipped to deal with minor surgical procedures. However, it is possible to perform extraordinary procedures successfully in some of these rural hospitals. For example, on June 20, 2012, six doctors from the 1982 graduating class of Christian Medical College in Vellore, Tamil Nadu, and their former professors successfully operated on conjoined twins in a village in Betul district of Madhya Pradesh. This was the first successful separation of conjoined twins in a rural setting in India. The equipment necessary for this operation was borrowed from private industry. The case demonstrates that if the government and the doctors care enough, such complex surgeries can be performed even in remote settings. Thus, operating rooms of several

varieties can still be seen in India, and one hopes that this diversity gradually changes to uniformity in times to come.

Accreditation for Quality Health Services. In 2006, the Quality Council of India established the National Accreditation Board for Hospitals and Healthcare Providers (NABH) to address the needs of consumers and to set benchmarks for the progress of the health industry. The accreditation by the NABH ensures high-quality care and patient safety in a given hospital. More hospitals in India are striving to obtain NABH accreditation, and to do so they have to achieve standards set by the NABH. Thus, the establishment of NABH is a welcome step toward ensuring quality health care in the country. Two hundred nineteen hospitals have received NABH accreditation so far. Although, this includes mostly private hospitals, some public hospitals have also been accredited by the NABH.[30]

The evolutionary development of anesthesiology in India has been a challenging and turbulent journey from the days when Mahatma Gandhi was operated on with the open-drop chloroform technique to today. However, it is satisfying to see that developments in anesthesia have kept pace with time in India. Even the heads of government such as governors, cabinet ministers, and the prime minister no longer travel to foreign countries for their complex surgeries. Anesthesiologists have access to most modern medicines and equipment to provide the care of the highest order to these officials. The use of balanced general anesthesia with drugs such as fentanyl, midazolam, sevoflurane, and atracurium, full-fledged monitoring, and pain relief by patient-controlled analgesia pumps is now readily available in larger hospitals.

Indian College of Anaesthesiologists. The idea of forming an Indian College of Anaesthesiologists (ICA) was conceived in 2001. The objective was to form an academic wing of the ISA that could subserve the function of supervision and guidance of anesthesia education all over the country so that uniformity in medical education is maintained. Thus, it is expected to function as a leading advisory body to the Medical Council of India. In addition, it has undertaken a major challenge of formulating practice guidelines and protocols for anesthesiologists in the country. The existing Western guidelines are often difficult to apply in the Indian scenario. The college also awards fellowships in anesthesia. The ICA was officially registered November 2008 and currently has 450 members.[31]

Japan (Naoyuki Hirata and Michiaki Yamakage)

The following summary of the facilities and equipment of anesthesia in Japan was excerpted, with permission, from the *Journal of Anesthesia*.[32]

In the 1980s, general anesthesia was mainly conducted using halothane or enflurane with nitrous oxide. Fentanyl, an opioid analgesic, was also available, but was rarely used because it was believed to cause delay in awakening. Epidural anesthesia was used more frequently than it is now. For example, cervical epidural anesthesia was generally used in surgery on upper limbs or for breast cancer. The only intravenous anesthetics available at that time were thiamylal and ketamine, which was administered to asthma patients despite its known secretion-promoting effects. The depolarizing neuromuscular blocking drug (NMBA) succinylcholine was used for induction of anesthesia, and the nondepolarizing NMBA pancuronium was the only NMBA available for maintenance of anesthesia. During the 1980s, there was no awareness of the progression of acute renal failure during emergency surgery, and some patients did not awaken from anesthesia for a long time after surgery because of the prolonged effect of pancuronium.

Since the 1980s, various anesthetic drugs have become available in Japan. The availability of a wide range of anesthetics and the development of anesthetic monitors have made anesthesia a much safer and more comfortable procedure for patients. However, Japan (possibly because of its unique medical system) lags behind the United States and Europe in the use of anesthetic drugs other than sevoflurane. Remifentanil, rocuronium, and desflurane have finally been launched in Japan. In 2010, sugammadex was approved for clinical use in Japan, 2 years later than in Europe. As of this writing, it has been reported that sugammadex shares 70% of the relaxant antagonists [market] in Japan, which may be the highest share in the world.

General anesthesia with airway management using a laryngeal mask is increasing in Japan because of the promotion of this device and the widespread use of ProSeal (Laryngeal Mask, Jersey, UK) with high sealability, which makes it easy to eliminate leaks around the mask. The indication for this method of anesthesia depends on the anesthesiologist, although it is generally not used for laparotomy, thoracotomy, or prolonged general anesthesia. If the device has high sealability and can withstand positive-pressure ventilation, anesthetic management is sometimes performed using artificial ventilation with the use of NMBAs. The use of the laryngeal mask is expected to continue to increase.

Because of the high costs of hospitalization in the United States and Europe, day surgery has become popular. Day surgery in Japan, however, is rare because most patients have national and private medical insurance. However, the duration of hospitalization is expected to become shorter with the introduction of a comprehensive medical system, although it is impossible to predict whether this will have an effect on the methods of anesthesia used.

Methods used for postoperative analgesia differ greatly between countries and between institutions in Japan. In the United States and Europe, patient-controlled analgesia is popular, and intravenous opioids alone are used in approximately two thirds of patients. The combination of intravenous opioids with epidural analgesia appears to be used only for patients who have undergone upper abdominal surgery or thoracotomy. In Japan, epidural analgesia with or without intravenous opioids is used for postoperative pain control in approximately 50% of patients.

Finally, the number of surgical cases in specialized hospitals, including university hospitals, is expected to continue to rise in Japan. This increase is related to the

Figure 2-10. The operating room at the American University of Beirut Medical Center, which shows the updated anesthesia equipment and monitoring of a patient undergoing coronary artery bypass grafting.

growing population of older patients and the increase in incompatibility complication; the number of cases anesthetically managed by neural block or general anesthesia alone is also expanding.

The Middle East (Anis Baraka and Fouad Salim Haddad)

The anesthetic machinery, monitoring equipment, and anesthetics used match the international standards that are approved by international societies, such as the American Society of Anesthesiologists (ASA). Every patient undergoing surgery under general or regional anesthesia is routinely monitored with electrocardiography, pulse oximetry, noninvasive arterial blood pressure monitoring, and end-tidal capnography. In critical care patients or in patients undergoing cardiac surgery, monitoring includes pulmonary artery catheterization, mixed venous oximetry, cerebral oximetry, intraarterial blood pressure monitoring, and blood gas analysis. Figure 2-10 shows the operating room and illustrates monitoring of a patient undergoing coronary artery bypass grafting at the American University of Beirut Medical Center, which has updated anesthesia equipment.

Preoperative checking of anesthesia equipment and gases and the labeling of drug syringes are routine practices. In addition, the "time out" policy confirming the identity of the patient, the type, and site of surgery are practiced before surgery by the anesthesiologist, the surgeon, and the operating room nurses involved in the surgical procedure.

Russia (Yury S. Polushin and Olga N. Afonin)

By the end of the twentieth century, the country faced a severe political crisis resulting from former President Mikhail Gorbachev's program of economic, political, and social restructuring called *perestroika*. The Soviet Union collapsed into separate and independent states, causing the destruction of the national economy and leading to violations of the links between the regions that had evolved over the years. In the field of medicine, the manufacture of medical equipment almost ceased while the pharmaceutical companies either stopped production or moved outside the country. The results were drastic in the lives of the Russian people. There was a change of economic structure, which led to the need to reform the system of medical aid to the population. This was a difficult period in the history of Russian medicine, with the breakdown of existing health care mechanisms and a void in establishing new systems of medical care. In anesthesiology and intensive therapy, which rely on sound economic factors, the situation was particularly difficult. In many small hospitals, units of anesthesiology were closed because it was not possible to update equipment and medications. The salary of doctors and nurses was extremely low, and the prestige of the specialty declined, leading to a considerable shortage of personnel. The All-Union Scientific Society of Anesthesiologists and Intensive Care of the U.S.S.R. ceased to exist, and it was replaced with a variety of regional organizations that did not have legal status or proper authority with the institutional health managers.

Just over 20 years after the end of perestroika, the economy has revived and the state can distribute considerable resources for the development of medicine. A new health care system has been developed, multifunctional medical centers have been built in several regions of the country, and funds have been allocated for the modernization of hospitals, including the anesthesiology and intensive care units. In 2011 a new order of the Ministry of Health of the Russian Federation was activated that defines the procedure for the provision of anesthesia and intensive care in hospitals. As a result of these changes, the field of anesthesiology is again recruiting young and active professionals. In addition, the Federation of Anesthesiologists and Reanimatologists of Russia has strengthened its position and is uniting its ranks with members of affiliated organizations in the Russian Federation, and communications between Russian anesthesiologists with colleagues from other countries has improved.

Of course, the reform of medicine is still far from complete, and some institutions still have not made noticeable changes. Although modern, influential, and well-equipped hospitals exist, there remains a need for medical services, particularly in remote regions that lack facilities and access to medical care. There is a great shortage of personnel, which limits the needed radical reform of the medical education system, including anesthesiology, to meet international requirements. However, progress is evident and is continuing at a gradual pace and with the support of the Russian Federation.

Southeast Asia (Florian R. Nuevo)

The biggest change in the region in the last 2 years is the mandatory use of pulse oximetry as a basic monitoring standard on any patient who is given an anesthetic that leads to changes on sedation levels. The requirement for pulse oximetry monitoring is part of the WHO Surgical Safety Checklist, which has become part of the requirements prescribed by most accreditation organizations in the region. Credit must be given to the WFSA, which has

worked closely with the WHO to make pulse oximeter monitoring a part of the surgical safety checklist. The WFSA has also made pulse oximetry a mandatory requirement at all levels of care in the 2010 WFSA International Standards for Safe Anesthesia Practice.

Although there is no robust database available to measure the reduced incidence of intraoperative deaths in the last 5 years because of pulse oximeter monitoring, no ASEAN anesthesiologist would readily agree to administer a general anesthetic without this monitoring device. Nevertheless, surveys among anesthesia care providers confirm that the change is palpable. The audit reviews also report this observation.

The safety of remote anesthesia continues to be a great challenge. Safe delivery of anesthesia is frequently compromised because of the limited availability of proper equipment and manpower. A typical example is the lack of MRI-compatible devices and equipment. Quite often anesthesiologists have to rely on visual assessment of breathing patterns in sedated patients during MRI procedures because MRI-compatible oximeters are not available.

The use of capnography in the operating room is still infrequent and usually limited to laparoscopic procedures. This situation is typical in low-to-middle income countries in the region. There is still much work to be done to make capnography a part of the safety standards for every patient who undergoes mechanical ventilation, not only in the operating theaters but also in ICUs.

Another persistent challenge in the region is the inadequate availability of anesthesia machines that have passed the safety standards prescribed by the American Society for Testing Materials. Because of this, the practice of mixing anesthetic gases, such as oxygen-air or oxygen-nitrous oxide, and applications of closed-circuit or low-flow anesthesia techniques are limited. The administration of 100% inspired oxygen is often the norm in places without modern anesthesia machines. In developing countries, there is a need for oxygen concentrators in clinical practice, because their use can reduce costs and make oxygen more readily available in difficult and remote work environments.

The advent of laryngeal mask airway devices has greatly improved the management of difficult airways in the region. Until recently, fiberoptic bronchoscopy was rarely available for use by anesthesiologists. Use of the LMA has curtailed the loss of lives of those who succumbed to failed intubations or difficult mask ventilation scenarios. A related and integral contributor to improved airway management in the region has been the addition of difficult airway workshops that are conducted in collaboration with industry in almost all anesthesia meetings throughout Southeast Asia.

Uganda and Sub-Saharan Africa (Ronald D. Miller and D.G. Bogod)

A recent editorial stated that the United States spent an average of $8233 per person per year for health care.[33] In contrast, in countries with either "low" or "intermediate" budgets, this expenditure rarely reaches $30 per person per year.[34] From a quality-of-care point of view, in a 2007 survey of more than a quarter of Uganda's anesthetic practitioners, only 23% thought that their facilities met all the widely accepted minimal standards for the practice of safe, adult anesthesia. Categories surveyed included access to updated information, basic operating room equipment, and the most basic supply of anesthetic drugs. For safe pediatric anesthesia, only 13% thought that their facility met the basic requirements.[35]

For spinal anesthesia techniques, more than half of the anesthesiologists surveyed did not have regular access to the necessary local anesthetics, and others did not have a ready supply of spinal needles. Only 23% could guarantee being able to find a brush to clean their tracheal tube between procedures.[35]

For cesarean sections in women during childbirth, nearly all the respondents (94%) said that they did not have the facilities to perform this procedure safely. More than three fourths did not have reliable access to magnesium sulfate, and half of them said that they could never get it.[35]As D.G. Bogod, editor-in-chief of *Anaesthesia*, wrote in the editorial of the issue in which these numbers were published:

The figures revealed by this survey show that despite the best efforts of all involved, 27 million Ugandans essentially enter a lottery every time they undergo anesthesia—a lottery with poor odds of a happy outcome. What the authors cannot tell us is whether this problem is confined to Uganda alone . . . it would be foolish to try to extrapolate from one country to another, but it is unlikely that Uganda data differ wildly from most of Sub-Saharan Africa. . . . If the situation in Uganda is bad, it is likely to be far worse in Ethiopia, Somalia, Tanzania and many other neighbouring countries.[35]

The above description was published in the seventh edition of *Miller's Anesthesia*. Have conditions improved in the last 5 to 6 years? Current literature is available regarding the status of personnel in anesthesia (described later). The status of facilities and equipment is less clear. A direct quote[36] is not encouraging:

The most common technique is general anesthesia (with spontaneous or manually assisted ventilation). Nonmedical anesthetists with limited training and supervision and lacking the most common drugs and anesthetic equipment administer anesthesia usually for emergency surgery . . . the morbidity and mortality rate is high.

This description strongly suggests a lack of facilities and equipment.

EDUCATION, ACCREDITATION, AND AVAILABILITY OF PRACTITIONERS

Brazil (Maria Carmona)

Currently, more than 10,000 Brazilian anesthesiologists are affiliated with the SBA, the second largest anesthesiology society in the world. In addition, a significant number of physicians not affiliated with the SBA or without a specialization also work as anesthesiologists, primarily in smaller towns and poor areas of the country. Yet, over the last decade, it has become evident that

there is a lack of anesthesia providers in most Brazilian cities because of the increasing elderly population, the diversity of surgical and diagnostic procedures, and the extension from 2 to 3 years for specialization in anesthesiology. Partly because of this shortage, clinical anesthesia is the main activity of Brazilian anesthesiologists with only a minority involved with intensive care, pain care, and research. This deficiency has led to an expansion in the number of training centers and positions for specialization in anesthesiology in most residency programs in the country.

In Brazil, residency in anesthesiology is regulated by both the Ministry of Education and the SBA, and approximately 650 physicians are admitted annually to a 3-year specialization program. Although the best residency programs are related to university hospitals, the majority of the 93 training centers are isolated programs in medium-sized hospitals. The residents have intensive training in the different areas that qualify them to administer anesthesia safely. All the centers are accredited, and they should offer good training in preoperative evaluation, the main anesthesia specialties, intensive care, and pain treatment. A practical and theoretical program is followed, and the residents are evaluated annually with a test conducted by the SBA, which publishes a ranking of the training centers based on specific criteria. The majority of candidates in residency programs are Brazilian, but a few candidates from other Latin American and African Portuguese-speaking countries have also participated. The official instructors on these residency programs are certified by the SBA, and few of these have PhDs. For PhD certification, which is the top title in anesthesiology, specialists undergo a multiple-choice test followed by an oral examination administered by a board assigned by the SBA.

The high quality of teaching and clinical care contrasts with the poor focus on research, which is the greatest weakness in the field of anesthesia in Brazil. There are few universities with well-structured anesthesia departments, and the effect of the few publications in existence is limited. Although the rules for the training centers also recommend that residents be involved in research projects, few universities are able to offer such opportunities. This situation is changing, and many training centers are realizing the importance of research as a way to improve education and assistance. Each year, a greater number of anesthesiologists are enrolled in the few postgraduate programs available in Brazil, and some PhD students are enrolled in postdoctoral programs in Brazil or abroad. The large number of attended cases is a robust base for observational and randomized clinical trials, and these are gradually increasing. The peer-reviewed *Brazilian Journal of Anesthesiology* is the official journal of the SBA, and it publishes most of the country's anesthesia research, together with other high-impact international journals in anesthesia or related areas.

Chile/South America (Guillermo Lema)

The training of anesthesiologists is a contentious issue in South America. There is a large discrepancy between the views of governments and those of anesthesia societies, and this relates to the number of anesthesiologists needed and the quality and duration of training required. All countries on the continent have anesthesia training programs of varying quality. The governments run a few, but universities conduct most of the programs.

There is agreement among all about the basic length of time needed for training; regardless of whether the government or the anesthesia society runs the program, 3 years is required to complete training. Some countries have added a fourth year with emphasis on research or a specific specialty; however, there is lack of financial support from governments, and this has stymied acceptance of this additional year. In addition, some countries have specific scientific organizations run by universities and scientific societies to certify the various places where anesthesia is taught. However, some facilities without proper certification contine to teach residents. Gradually, these places are being restricted from teaching.

Governments and scientific societies also view the requirements for anesthesiologists differently. Governments are pushing for more practitioners, whereas universities prefer better training. Despite such difficulties, anesthesiologists and their scientific societies have campaigned for greater influence in the process of accreditation.

Although advances in medical training by the universities, anesthesia societies, or both, continue, there remains the issue of an inadequate number of practitioners. Public hospitals do not have enough anesthesiologists, and universities are teaching at full capacity. In an effort to create more practitioners, governments are driving the universities to enroll more students, while the universities are concurrently striving to accommodate the growing number of students and provide quality education. Both institutions are diligently working to meet their respective needs. The results will be seen in the near future.

Anesthesia meetings achieve the goal of educating residents and older generations of anesthesiologists. Anesthesia journals are in existence, and although none are comparable to the Institute for Scientific Information, efforts are being made to become part of international medical databases.

China (Yuguang Huang)

Currently in China, medical students are educated for 5 to 8 years in medical colleges (5 years for undergraduate education and an additional 3 to 5 years for a master's or doctoral degree), followed by a resident training program of 5 years.

Differences in education quality still exist among medical colleges across the country because of imbalances in local economies. Despite the improved overall standard of anesthesiologists in the country, it is obvious that in primary-level hospitals, both the clinical performance of the resident and the level of resident training are still relatively low. As a result, anesthesia providers in larger medical centers usually excel beyond their counterparts at primary-level hospitals by a large magnitude.

To address the imbalanced human resource distribution in different areas, the government has been promoting standardized resident training nationwide since 2000. The act was first implemented in pilot centers in Sichuan, Beijing, Shanghai, and other large cities and

has extended to all the other cities throughout China. Medical graduates are required to start their training at an accredited institution upon graduation, and only those who have passed national examinations receive their license. The *Anesthesiology Standard Regulatory Protocol* released in 2012 clearly states the requirements for anesthesiologists in different hospitals; these requirements will help to improve the basic knowledge and clinical practice of young anesthesiologists in primary-level institutions. Meanwhile, the Chinese Medical Association and Chinese Society of Anesthesiologists have also been providing various continuing medical education programs to local hospitals. The overall professional level of Chinese anesthesiologists is expected to be elevated through such efforts.

In summary, the Chinese anesthesiologist team is continuing to evolve. As anesthesiologists have gained prominence in China, more medical graduates are selecting anesthesia as their career after graduation. Graduates with higher education levels are primary contributors to the medical team. In some well-known medical centers, personnel with master's and doctoral degrees hold over 75% of the positions in the department. However, there is a significant gap between the country's urgent clinical needs and the number of competent anesthesiologists. This situation requires additional recruitment efforts.

Europe (Lars I. Eriksson and Jannicke Mellin-Olsen)

Shortly after the European Economic Community (EEC) was established in 1958, representatives from professional organizations representing the Inner Six founding member countries (Belgium, France, West Germany, Italy, Luxembourg, and the Netherlands) created the European Union of Medical Specialists (UEMS). The UEMS soon established contacts with the EEC to define basic principles for medical specialist training in Europe. The aim was to define a high level of training with common general criteria for future European medical specialists, which would lead to harmonized and coordinated specialist training throughout Europe. It would also facilitate the free movement of European specialists from one member country to another. As a tool to achieve this objective, the UEMS created Specialist Sections for the main specialties in 1962. One of these sections is the European Section and Board of Anaesthesiology (EBA), which includes reanimation and intensive care medicine. The role of the EBA is political, working as the anesthesiology branch of UEMS and the EU. EBA is also the interface with other medical specialties including multidisciplinary fields such as critical care and pain medicine, education, and patient safety.

Migration and Work Force Shifts. The EU has defined the duration of training needed to become a specialist in anesthetics to be 3 years; however, in most EU countries, it currently takes 4 to 7 years to fulfill the requirements of a certified anesthesiologist. The content of the training programs varies largely by country with the specialist certificate awarded by each individual country. Yet, being on the specialist register in one EU country entitles the person to be accepted as a specialist in any other EU country, in line with the principle of free movement of specialists within Europe. Although in accordance with the EU spirit, this can create problems. Sometimes, the hired anesthesiologist is not qualified to work in the local setting of another EU country because of insufficient or inappropriate training and lack of language skills.

As in other parts of the world, the quality of care in hospitals and the opportunities for professional and economic development are in general better in the cities. Similarly, the less affluent EU member states that invest in the training of anesthesiologists often do so only to see their practitioners move to other countries within the EU, typically from Eastern to Western Europe. Of course, the main driving forces behind this migration are better economic and professional development opportunities. Recently, financial issues have led to new routes of work migration with practitioners moving from southern European countries to the north.

The supply and demand of anesthesiologists varies considerably between parts of Europe for many reasons. All countries are experiencing an increased aging population who require more health interventions, thereby increasing the demand for workers. Another contributing factor is the European Working Time Directive, a mandatory regulation that limits the number of hours any person is allowed to work per week. In addition, there is an increasing tendency by younger anesthesiologists of both genders who want to spend more time with their families and less time in the hospital. All these issues underlie the current labor shortage that exists in a majority of EU member states.

The shortage of specialists is not made easier when governments fail to foresee the consequences of shortsighted planning and then have to seek ad hoc solutions when avoidable problems arise. This seems true for all countries, but it manifests in various ways depending on a country's historical and cultural factors. When financial restrictions are added to these factors, even traditionally rich countries have to face the probability of compromising their standards by reducing training requirements and recruiting less educated anesthesia providers.

However, statistics on workforce availability and migration in Europe are ambiguous and often associated with error. Unfortunately, the data do not reflect whether individuals are working full time or whether an anesthesiologist is registered in more than one country. Some medical students go abroad to study and return to their home countries but are then counted as a migrated doctor. These issues all add to the complexity of workforce planning. Despite the statistical shortcomings, there is no doubt that the average number of anesthesiologists in Europe has increased over the last few decades.[19,37] The increase is larger in older EU member countries than in the newer ones because of demand, training, availability, migration, and other factors. The average number of anesthesiologists is unscientifically estimated as 14.5 per 100,000 population in Western Europe, but in the East it is only 6.1 per 100,000 population.[19]

In most European countries, health care is funded by the government, although there are local exceptions. Whereas more than 50% of anesthesiologists in some Western European countries (Luxembourg, the

Netherlands) are involved in private practice, anesthesiologists within Scandinavia and the United Kingdom rarely (less than 5%) work in private practice, although the number is increasing.

European Society of Anaesthesiology. The European Society of Anaesthesiology (ESA) is Europe's counterpart to the ASA; however, there are differences. Whereas the ASA is the national society of one country, the ESA Council consists of representatives from 30 nations (data from 2013). European countries with 25 individual members or more (or more than 10% of practicing anesthesiologists in smaller countries) are entitled to council representation. The council members serve to facilitate and harmonize the activities of national and international societies of anesthesiologists in European countries. In addition, all national societies in Europe have formed a separate body within the ESA, known as the National Anaesthesia Societies Committee.

The objectives of the ESA are to promote the exchange of information among European countries; to disseminate information on anesthesiology; to raise the standards of the specialty by fostering and encouraging education, research, scientific progress, and the exchange of information; to promote and protect the interest of its members; and to promote improvements in safety and quality of care of patients undergoing anesthesia by facilitating and harmonizing the activities of national and international societies of anesthesiologists in European countries.

The Euroanaesthesia Annual Congress is the main scientific event of the ESA, but other scientific meetings are arranged, such as the autumn meeting. Education, research, and providing specialty resources are also major activities of the ESA.

European Postgraduate Training Program in Anesthesiology, Pain, and Intensive Care Medicine. In 2011, the EBA published a completely revised postgraduate training program in the specialty[38] based on consultations with national societies, the ESA, and other stakeholders. The new program is considered a paradigm shift from structure- and process-based to competence-based training.

Some years ago, an EU directive mandated a 3-year training program to become a specialist in anesthesia; however, that decision was made at a time when the complexity of anesthesia was much less. This directive is still valid, but the current duration in most EU countries varies from 4 to 7 years, and it is described as a traditional process-based education model. Several governments have recently tried to reduce the duration of training in an effort to train more anesthesiologists in less time and more inexpensively, but this has been fiercely opposed by the EBA.

Since 2001, the EBA has stated that the minimum duration of training should be 5 years, of which at least 6 months should be spent in critical care, 3 months in emergency medicine, and 3 months in pain therapy. Simulation-based training, logbooks, and portfolios were recommended. These guidelines were streamlined and developed further in 2008. The resulting 2011 program requires training of at least 5 years, but with at least 1 year specifically directed to intensive care medicine training. The guideline now states the minimum estimated time required to achieve the defined competences to fill the roles of an anesthesiologist, rather than just a description of length of time.

The training program builds on the competency initiative—the Canadian Medical Education Directives for Specialists definition of the seven roles of a medical specialist. In turn, a list of 10 domains of general core competencies (e.g., disease management, patient assessment and preparation, anesthesia nontechnical skills, and quality-safety-management-health economics) and seven domains of specific core competencies (e.g., obstetric anesthesiology, multidisciplinary pain management) were described. For all competencies in each domain, learning objectives are defined in the form of knowledge, technical skills, clinical and case-management skills, drills, and specific attitudes. This has resulted in a completely new syllabus.

The new curriculum requires new assessment tools, in addition to the old summative examinations.[39] Examples are self-assessment, evaluation of clinical performance, and patient management problems. New online assessment systems are being launched in all-in-one formats. The new curriculum has been introduced in Moldova and Romania, and several other European countries are changing their education systems.

European Diploma in Anesthesiology and Intensive Care. Introduced in 1984, the European Diploma in Anesthesiology and Intensive Care (EDAIC) remains the recommended theoretical examination tool. It is a multilingual, end-of-training, two-part examination covering the relevant basic sciences and clinical subjects for a specialist anesthesiologist. It provides an international European standard that allows harmonization of training and assessment of knowledge across Europe. The EDAIC has been adopted as the national examination in Austria, Switzerland, Hungary, Poland, Malta, Romania Slovenia, Turkey, the Czech Republic, Moldova, Finland, and in 2014, the Netherlands. In 2007, non-Europeans were also allowed to sit for the EDAIC, as stated by the Glasgow Declaration by the Council of European Specialist Medical Assessments. Although the EDAIC does not represent a ticket to work in Europe, the examination has become increasingly popular worldwide.

EDAIC Part 1 consists of multilingual, multiple-choice questions, one part on basic physiology, pharmacology, physics, clinical measurement, and statistics, and a second part on clinical practice associated with anesthesia and its subspecialty areas. It is to be taken after approximately 2 years of anesthesiology training. Part 2 consists of four oral examinations, each with two examiners moderating each other. Candidates may choose the language in which they wish to be examined within the constraints available at the examination center. Part 2 is an end-of-training examination, and successful completion qualifies the candidate to receive the EDAIC. Because the EDAIC is an assessment of theoretical anesthesia knowledge, it must be supplemented by the local assessment of skills and professional attitudes or behavior that takes place in each country according to local systems and is

a requirement before an individual can be placed on the specialist register in that country.

The Committee for European Education in Anaesthesiology (CEEA) was formed as a foundation, Foundation for European Education in Anaesthesiology (FEEA) in 1986. The program consists of a cycle of six courses, covering all the fields of anesthesia, intensive care, emergency medicine, and acute pain management. The program is to be completed in sequences of 3 years and is conducted in the national language of each country. The initial aim was to provide continuing medical education in anesthesiology within the European Community. With the expansion of the EU, the FEEA was introduced to the new member countries and to other European countries. Since 1995, new centers have been established in cooperation with the WFSA in other parts of the world, such as Latin America, Africa, and in Asia. In 2009, the FEEA activities were transferred to the ESA, and the CEEA was created as a joint committee of the ESA and WFSA. Currently, there are more than 100 regional CEEA centers.

ESA/EBA Joint Hospital Visiting and Training Accreditation Program. The ESA/EBA Joint Hospital Visiting and Training Accreditation Program (HVTAP) has been in place since January 1996 as a joint permanent committee of the ESA and the EBA. The goal is to encourage and enhance training standards across Europe and to ensure that an academic institution meets the prerequisites of training in anesthesiology specified in the EBA training guidelines. Together with the EDAIC, the HVTAP serves to improve the overall quality of the specialty of anesthesiology and to harmonize its activities throughout Europe. The visit consists of a detailed presentation of the staffing and organization of the hospital, the department (or the institute), and the structure of training. This forms the basis for discussion and evaluation of all aspects of the teaching and training process with the staff members involved for the purpose of complementing and building on strengths and encouraging development and change to address areas of weakness. A subsequent comprehensive report of the visit, together with recommendations for improvement or accreditation (or both), is presented by the program committee.

India (Deepak K. Tempe)

In India, there are mainly two types of postgraduate qualifications that can be obtained in the field of anesthesiology. The first, provided by medical colleges (MD in anesthesiology, a 3-year degree program), is governed by the Medical Council of India, which oversees the syllabus and other teaching and training standards. The second one is provided by the National Board of Examinations, which awards a Diplomate of National Board (DNB). In addition, the Medical Council of India regulates the diploma in anesthesiology (DA), which is a 2-year training program that is available at medical colleges.

In 1992, it was determined that no new medical college or postgraduate course could be started without the prior approval of the Medical Council of India, and its recommendation became mandatory for all medical colleges. Thus, it was only after the addition of this section, known as *10a,* that teaching and training in the medical field in India were standardized and minimum standards were enforced. In 1998, a Supreme Court judgment reinforced the statutory body's position in establishing and maintaining high standards of medical education and recognition of medical qualifications in India. The recognition awarded by the Medical Council of India for all courses must be reviewed every 5 years by a Medical Council of India inspection team. Thus, teaching and training in anesthesiology in India are standardized through the setting of minimum standards throughout the country in terms of the facilities (space, equipment, manpower, and infrastructure) and the syllabus.

Growth of the Specialty. The interest of Indian medical students in the specialty of anesthesiology has shown a dramatic increase during the last decade. Previously, candidates for a postgraduate course in anesthesiology were admitted based on scores obtained on the MBBS examination. The practice now is to conduct a common entrance examination, with admission into a given subject area based on the rank attained by the student. In a few states such as Delhi, this has been the practice for approximately 25 years.

Table 2-2 shows the top and bottom ranks that were admitted into an MD anesthesiology program between 2002 and 2007 in the states of Maharashtra and Delhi. The table indicates that interest among students to learn and practice anesthesia is increasing. Over the years, the situation has remained more or less similar, except that the total number of MD seats has more than doubled. Reasons for the growing interest in anesthesia among students could be related to the increasing scope of anesthesia (as discussed earlier) and better job prospects. In addition, other fields such as general surgery and general medicine require further subspecialty training, and this could be motivating students to pursue anesthesia. In Delhi, anesthesiology is among the top six specialties preferred by medical students, along with radiology, dermatology, pediatrics, orthopedics, and gynecology. This development is in sharp contrast to the situation 15 to

TABLE 2-2 **OVERALL RANKINGS OF POSTGRADUATE STUDENTS ENROLLED IN ANESTHESIOLOGY PROGRAMS IN MAHARASHTRA AND DELHI (2002-2007)**

	Maharashtra		Delhi	
Year	Top Rank	Bottom Rank	Top Rank	Bottom Rank
2002	228	854	65	98
2004	No exam		53	96
2005	405	642	32	96
2006	160	606	33	99
2007	106	504	61	85

The total number of postgraduate seats in all subjects is 140 in Delhi and 450 in Maharashtra. The students often sit for entrance examinations in several states, which probably explains why the last rank exceeds the number of seats in Maharashtra.

20 years ago, when anesthesiology was among the bottom five choices.

There are a total of 381 medical colleges in India with 50,078 seats.[40] Of these, there are 1386 seats in MD anesthesia and 644 in DA anesthesia. In addition, the Ministry of Health and Family Welfare of India recognizes the DNB as a qualification in the given field and equates it with the postgraduate degrees awarded by other Indian universities. There are approximately 200 DNB seats in anesthesiology.

Assigning seats is especially challenging because it remains unclear just how many anesthesiologists India needs. According to one estimate, there are approximately 35,000 to 40,000 anesthetists in India for a population of 1.27 billion (personal communication, Dr. Anjan Dutta, President of ISA). The majority of these anesthesiologists are in cities. This number is far too few as compared with the United Kingdom, which has 12,000 anesthetists for a population of 64 million.[41] This fact has been recognized by health officials and, as a result, the number of postgraduate seats in anesthesia has more than doubled during the last 5 years. Major factors that limit any additional increase in the quantity of seats are the inadequate supply of recognized medical teachers and the limited number of medical colleges. Consequently, although the situation has improved, the shortage of anesthetists continues. It is generally believed that in the interest of safety, short-term courses in anesthesia should be discouraged to fill this deficiency.[42] The ISA has also suggested that during the teaching course of MD, the final-year student can have a rural posting for 3 to 6 months with one qualified anesthetist.[43] However, the government is actively considering a short-term training course in obstetrics anesthesia (3 to 6 months) for MBBS doctors to provide much needed anesthesia services to improve maternal health. Some states, such as Andhra Pradesh, already have this in place while other states are considering it. The Delhi High Court has proclaimed that training for life-saving anesthesia skills and emergency obstetric care will continue until the requirement of anesthesiologists is fulfilled[32]; however, these doctors will be allowed to administer anesthesia only in government rural health centers.

Japan (Naoyuki Hirata and Michiaki Yamakage)

In Japan, the specialty of an anesthesiologist is certified differently by the government and by the JSA. To be certified by the government, a trainee anesthesiologist must perform general anesthesia in more than 300 cases over a 2-year period under the supervision of certified anesthesiologists. On the other hand, the JSA certifies anesthetic specialists by clinical training over a 5-year period in various types of anesthesia that include academic activities and success in oral, written, and skill examinations. The present examination pass rate is approximately 60%. To update the certification of the JSA (the government does not require updates), anesthetic specialists must report on their anesthetic case experience, teaching career, and academic activities every fifth year. When the first renewal is accepted by the JSA, the anesthetic specialist is also qualified as a supervisory anesthesiologist. Thus, 10 years of substantial experience in the field of anesthesiology is required to be certified as a supervisory anesthesiologist in Japan.

The Middle East (Anis Baraka and Fouad Salim Haddad)

The departments of anesthesia in the different countries of the Middle East are staffed by highly qualified academic faculty certified either by the Arab Board or by foreign academic bodies, such as the American Board of Anesthesiology of the United States and the Faculty of the Royal College of Anaesthetists of the United Kingdom.

Anesthesiology training following MD graduation consists of 4 years of residency in a recognized medical center. This may be followed by 1 to 2 years of a subspecialization fellowship in areas such as pain management, critical care, obstetric anesthesia, cardiopulmonary anesthesia and more. Anesthesia specialization and Board certification by the training hospitals must be recognized by the anesthesia societies within the respective countries, which also track medical training, as well as continued medical education.

In addition to the annual regional anesthesia society conferences such as Egyptian Anesthesia (Fig. 2-11, *A*), and the Pan Arab Congress of Anaesthesia (see Fig. 2-11, *B*), the Anesthesiologists of the Middle East participate actively in the activities of other national society meetings such as the Pan African meetings, and the annual meetings of the ESA and the ASA. In addition, they actively participate in the administrative and academic activities of the World Congress of Anaesthesiologists (WCA) and the WFSA.

Russia (Yury S. Polushin and Olga N. Afonin)

As of today, anesthesiology education in Russia still requires revision and improvements. There is need for structured residency programs that teach the standards accepted around the world, which are based on decades of experience in the safe practice of anesthesiology. The Academy of Postgraduate Education recently introduced new standardized tests, comparable to internationally accepted graduation examinations that permit objective measurement of the knowledge of newly graduated anesthesiologists.

Southeast Asia (Forian R. Nuevo)

The required number of years of training in anesthesiology varies among the member countries of the ASEAN region between 2 to 3 years (Table 2-3). Some countries follow the European model, and some adopt the American model (see Chapter 9), whereas others develop a hybrid model that is a combination of training programs from across the world. Of course, selection of an appropriate model is heavily influenced by the country's prevailing education system, which has been in place from the time it was colonized through the time it gained sovereignty. Currently, the lack of anesthesia care providers continues to be a persistent problem, and most countries are reviewing their respective curricula to address their particular needs.

An education abroad, such as in the United States or Europe, can be cost prohibitive for many young physicians,

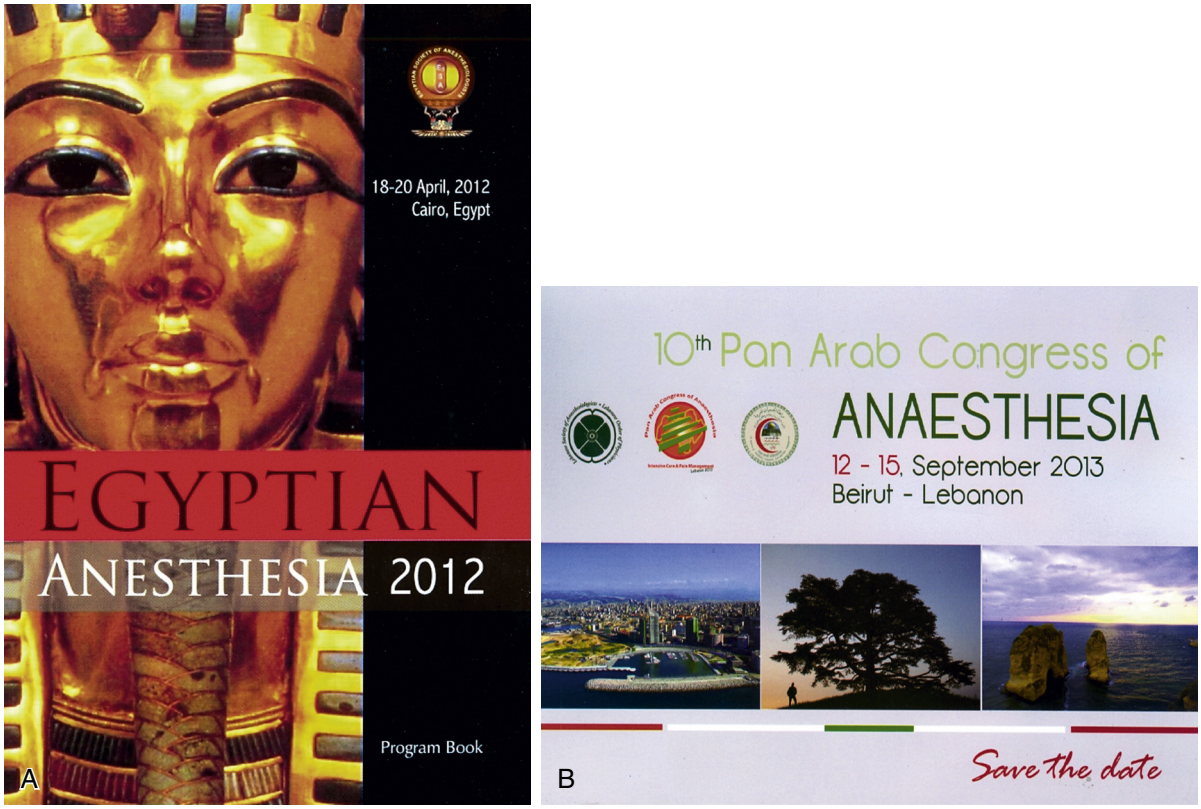


Figure 2-11. A, The Annual Conference of the Egyptian Society of Anesthesiologists, 2012. **B,** The Pan Arab Congress of Anaesthesia, 2013.

TABLE 2-3 **ORGANIZATIONS, CERTIFICATION REQUIREMENTS, AND RECOGNITION OF ANESTHESIOLOGISTS IN SOUTHEAST ASIAN COUNTRIES**

	Indonesia	Malaysia	Philippines	Singapore	Thailand
Influence on medical education	Britain	Britain	United States	Combination Britain + United States	Britain
Anesthesia					
Residency	3.5 years		3 years		3 years
Subspecialty fellowship	Variable number of training years, depending on subspecialty				
Pain			Yes	Yes	Yes
Obstetrics			Yes	Yes	
Cardiovascular/ thoracic	Yes	Yes	Yes	Yes	Yes
Pediatric			Yes	Yes	
Intensive care		Yes		Yes	Yes
Neuroanesthesia	Yes	Yes		Yes	Yes
Certifying body	Collegium of Indonesian Anesthesiologist	Malaysian Society of Anesthesiologists	Philippine Board of Anesthesiology	Singapore Society of Anesthesiologists	Royal College of Anesthesiologists in Thailand

particularly those coming from low- to middle-income countries. Thus, many young anesthesiologists select Singapore, Malaysia, or Thailand for anesthesia subspecialty fellowships because of the country's proximity and affordability. Furthermore, these training destinations are equally excellent centers of learning. However, in Indonesia, there are only 10 accredited training institutions, and being admitted into a program on the anesthesia fundamentals can be nearly impossible for many Christian Indonesians. As a result, many come to the Philippines for their 3-year anesthesia residency training, which is facilitated by institutional memorandum of agreements. The Philippines has accepted anesthesia trainees from many countries, including Nepal.

Anesthesiology Center for the Western Pacific. In January 1970, the Philippines established the Anesthesiology Center for the Western Pacific (ACWP) in Manila. It had an 11-month course on the basic fundamentals of anesthesia. This was a joint activity of

the WHO Regional Office for the Western Pacific, the University of the Philippines, the China Medical Board, and the WFSA.

The rationale for the creation of the ACWP was to help alleviate the shortage of reliable anesthesiologists in the region and to underscore the importance of administering safe anesthesia. The center did not seek to provide a complete training program; rather its purpose was to emphasize the basic sciences in anesthesiology. It created a foundation for students to build on so that they could eventually qualify, through further training, as specialist anesthesiologists.

Students at ACWP were from the Pacific Islands, Southeast Asia, southern Asia, Hong Kong, Taiwan, Korea, Japan, Iraq, Russia, and Sudan. The program served the region for 16 consecutive years, and many of its graduates have become respected leaders in anesthesia and have contributed to the development of anesthesia programs and safe anesthesia care in their respective countries. Unfortunately, in 1986, the ACWP ceased its operations.

Bangkok Anesthesia Regional Training Center. After the closure of the ACWP, a very timely project arose in Thailand. The Bangkok Anesthesia Regional Training Center (BART) was created with modest financial assistance from the WFSA Education Committee. The impetus behind the formation of the BART was the need to train anesthesiologists from the neighboring countries of Laos, Cambodia, Vietnam, and Mongolia. This program is still operational and is a source of pride, because BART graduates have all gone back to their countries of origin and helped to advance the field of anesthesia in their respective workplaces.

Uganda and Sub-Saharan Africa (Ronald D. Miller and D.G. Bogod)

In a survey by Hodges and colleagues,[44] there was only one medical anesthesiologist among the 91 anesthesia practitioners who participated in the survey, which means that, as is often the case, many trained physicians in Uganda probably traveled to the West to obtain a better life for their families. In addition, based on the survey, access to up-to-date textbooks seems iffy at best—fewer than half of those surveyed have access to such texts.[35]

The preceding paragraph, published in the seventh edition of this text, pointed to an inadequacy of trained anesthesia personnel and equipment that is being increasingly recognized. As stated in 2007, "the absolute numbers of anesthesiologists decreased during the nineties. Most anesthesia was delivered by nurse-anesthetists, either certified or trained on the job."[34] Because of age, a shortage will occur in 15 years. Experienced anesthesiologists are now so few that, in most countries, the critical mass of knowledgeable specialists no longer exists to train new anesthesia providers.

These conditions and inadequacies have been recognized by international anesthesia groups and organizations for years. Many improvements have been made (e.g., increased use of pulse oximetry). A few years ago, a "parallel anesthesia and surgical provider training program was started in Sub-Africa in a rural hospital." Basically, this program was designed to provide integrated care to a certain geographic area. Although the specific outcome of this organizational approach was not described, there is evidence of creativity in trying to solve basic inadequacies in health care delivery.

Encouragingly, communications in *The Lancet* are appearing regarding anesthesia-related mortality in Sub-Saharan Africa. With the advancing sophistication of information technology, comparison of outcome data among countries and/or areas of the world are possible. Bainbridge and associates[45] compared anesthesia related mortality between developing and developed countries. The anesthesia-related mortality rate was at least twofold to threefold more frequent than in developed countries. Cesarean section was the most common procedure with a mortality rate of near 1%.[46] Further, in several low-income countries, anesthesia is administered almost exclusively by nonphysicians, regardless of the patient's physical status and often without supervision.

The attention that developing and poor countries are receiving regarding anesthesia care will likely improve that care. The evolution of information technology will probably become more important and direct our attention to where it is most needed. While emphasis has appropriately been on mortality rates, more sophisticated and detailed outcome data are required so that resources can be directed in a productive direction.

SUBSPECIALIZATION

Brazil (Maria Carmona)

As part of its focus on improving the progress of anesthesiology in Brazil and stimulating educational and regulatory activities, the SBA has created specific member committees, such as those for ambulatory anesthesia, cardiovascular and thoracic anesthesia, obstetric anesthesia, pediatric anesthesia, regional anesthesia, venous anesthesia, perioperative medicine, palliative care, organ transplants, sleeping disturbances, malignant hyperthermia, resuscitation, trauma care, difficult airway, and more recently, committees related to occupational health and quality and safety. The resuscitation and the difficult airway committees develop specific workshops related to continuous education and training on these topics. The SBA also offers both a physical and virtual library that deliver scientific publications on demand, as well as video lessons previously delivered in society meetings or specifically prepared for attendees of the residency program.

Chile/South America (Guillermo Lema)

In South America, only Colombia and Chile have specialty laws. In all other countries, physicians can perform professional actions without a law to certify the proficiency and quality of care and protect patients. In fact, physicians with a low level of training have practiced anesthesia for many years; in most of these countries, paramedical personnel have performed anesthesia because of the lack of sufficient medical personnel or interest in the specialty. In some countries, surgeons conduct both anesthesia and surgery with the help of technical personnel. This practice

has been abandoned in most countries, but in countries such as Bolivia, Ecuador, Paraguay, Peru, and Venezuela, this situation persists and with government authorization.

Currently, the law in most countries specifies that only physicians can provide anesthesia; however, the shortage of trained physicians has left some countries with inadequately trained ones. Nevertheless, the process of certification of specialties, including anesthesia, is present in several countries. Most countries have medical organizations and anesthesia societies demanding proper certification methods. In Chile, Colombia, and other countries, the government has definitively reached agreement on minimum standards for certification in all medical specialties. It includes the recognition that only certain universities with full accreditation can teach medical specialties. So, as of the end the end of 2013, only colleagues who complete their studies in accredited institutions will be considered anesthesiologists, and only they will be allowed to work in public hospitals and private clinics.

India (Deepak K. Tempe)

For more than two decades, anesthesiologists have recognized the need for dedicated practice in the field of cardiac anesthesia and neuroanesthesia. There are anesthesiologists who are working exclusively in these specialties, but very few separate departments of cardiac anesthesia and neuroanesthesia exist. The All India Institute of Medical Sciences (AIIMS), a group of autonomous public medical colleges of higher education, is an exception in this respect because it created two such departments in 1986. Postdoctoral courses in these specialties have been started in the country. AIIMS has conducted the courses in both specialties since 2002, whereas the Sri Chitra Tirunal Institute of Medical Sciences, Thiruvananthpuram, has offered a course in cardiac anesthesia since 2003. The number of seats, however, is grossly inadequate, with four seats in cardiac anesthesia and two in neuroanesthesia. The National Board of Examinations started a DNB fellowship program (2 years) in cardiac anesthesia in 2002; it began with 4 seats, and the number has increased to 18. The Medical Council of India has now recognized the separate subjects of cardiac anesthesia (based on a Gazette of India notification dated July 24, 2009) and neuroanesthesia (based on an amendment notification dated December 8, 2010). This recognition allows all medical colleges to start the postdoctoral courses in these specialties, and the number is likely to increase.

Japan (Naoyuki Hirata and Michiaki Yamakage)

Although most anesthesiologists in Japan have performed various methods of surgical anesthesia, it has been well recognized that cardiovascular anesthetic management requires specialized experience. Recently, TEE has been recognized as essential for diagnosis and intervention during cardiovascular anesthesia. The Japanese Society of Cardiovascular Anesthesiologists has established a qualification system that certifies specialists of cardiovascular anesthesia. To be a specialist, significant clinical experience with cardiovascular anesthesia and passing of the TEE examination, created in 2004 by the Japanese Board of Perioperative Transesophageal Echocardiography, are required. These specialized anesthesiologists may further improve cardiovascular anesthetic management.

PROFESSIONAL AND RESEARCH ACTIVITY

Brazil (Maria Carmona)

The SBA is a highly structured association that is also in charge of the monitoring and engagement with federal and state legislative and regulatory activities affecting the practice of medicine by anesthesiologists. The SBA website (http://www.sba.com.br) also has a specific area for communication with the lay public. The SBA promotes an annual congress of anesthesiology, and the state and regional societies promote their own congresses. Besides presenting scientific and educational topics, the congresses provide a venue for meetings of the educational and political committees. Every 4 years, the Brazilian Congress of Anesthesiology occurs in conjunction with the Portuguese Society of Anesthesiologists. The SBA's association with other South American societies of anesthesiology, all of them Spanish speaking, is less expressive, but the Latin American Society of Regional Anesthesia is in charge of the development of this area of anesthesia in South America and promotes its own annual congress and other activities.

In conclusion, the well-established teaching programs, along with the emerging economic situation in Brazil, are major contributors to the growth of good anesthesia care throughout the country.

Chile/South America (Guillermo Lema)

Time, funding, and expertise are the basic requirements for research of sufficient quality to support publications or communications internationally. These requirements are not found widely in South America. Only a few university anesthesia departments have the capability of producing clinical research of sufficient quality to be published in esteemed journals such as the Institute for Scientific Information, notably in Chile, Brazil, and Argentina. The government and some colleagues have argued that research is not important in a continent that has more pressing priorities. This author does not agree.

Research is a tool for learning, and it should be encouraged, at least at university-based anesthesia residencies. Unfortunately, research does not generate income, and most of the clinical groups are not willing to dedicate time or money to this particular activity. Funding is lacking, and although some countries have national research grants to support clinical research, most do not. Basic research in anesthesia virtually does not exist in South America.

Financial support from pharmaceutical companies is weak, usually depending on the effects of their drugs in a clinical setting. Because of economic constraints, a large number of generic drugs are used; therefore, major pharmaceutical companies are not willing to support activities of this nature.

Conflict of interest has become a major issue; yet its regulation is weak. Many anesthesia departments in

private and public hospitals face financial limitations, and in this author's opinion, it is obvious that the tendency is to ask for support from companies in the medical industry. Although anesthesia is not a large recipient of medical industry funds, other specialties (e.g., cardiology, ophthalmology) are supported by the industry without restraint.

China (Yuguang Huang)

There are now two large anesthesia academic organizations in China: the CSA and the Chinese Association of Anesthesiologists. The CSA seeks to improve the national academic level in anesthesiology and to offer patients higher standards of clinical service. The Chinese Association of Anesthesiologists was established in 2005 and is focused on team construction and humanistic concern for anesthesiologists. Annual meetings are held in September for the CSA and in April for the Chinese Association of Anesthesiologists, with attendance in the thousands for each. As general anesthesiology has advanced, its subspecialties have also flourished with the start of several subspecialty academic groups. More than 30 clinical guides and expert consensus materials have also been published.

In 1986, the Beijing International Conference on Anesthesia was held successfully. Many experts from abroad, including Professor Ronald D. Miller (this textbook's editor), were invited to join as keynote speakers. From that point on, Chinese anesthesiologists began to communicate more with international professionals. At the first Sino-Japanese Clinic Anesthesia Symposium held in 1986, the CSA and Japan Society for clinical Anesthesia agreed to hold a symposium every 2 years.

The rapid development of the discipline has led to increasing opportunities for Chinese anesthesiologists to communicate and exchange information with their international colleagues. Some of them have obtained recognition from international organizations. Several renowned Chinese anesthesiologists have been admitted into well-known international anesthesiology societies. Professors Rong Xie, Ailun Luo, and Xinmin Wu were named Honorary Academician by the Royal British College of Anaethetists. Professor Yuguang Huang was nominated President Elect for the International Society for Anaesthetic Pharmacology in 2012 and Board Member of the worldwide Primary Trauma Care Foundation. Professor Lize Xiong was elected as a standing committee member of the WFSA in 2012. Professor Yunxia Zuo was elected as President for the Asian Society of Paediatric Anaesthesiologists in 2012.

Anesthesiology publications in China include *Chinese Journal of Anaesthesiology, Journal of Clinical Anaesthesiology, Journal of Pain Medicine,* and the Chinese edition of *Anaesthesia and Analgesia*. More than 100 research programs in anesthesiology are supported by the National Natural Science Foundation of China each year, and large scientific grants have been invested in anesthesiology research in the past years. Authors from mainland China publish more than 500 Science Citation Index manuscripts per year on average, and more presentations and publications have been released at international meetings year by year.

Europe (Lars I. Eriksson and Jannicke Mellin-Olsen)

European Academy of Anaesthesiology. Before the formation of the European Academy of Anaesthesiology (EAA) in 1978, there was no formal representative structure except the EBA for the specialty within Europe. The five statutory aims of the EAA were (1) to raise the scientific level of the discipline; (2) to improve the training of anesthetists, their clinical and theoretical education, and their competence at the completion of the training period by holding examinations; (3) to hold scientific meetings, conferences, and seminars; (4) to facilitate research in anesthesia and its associated disciplines; and (5) to promote exchange among anesthetists and discussion of all matters concerning their profession.

The EAA had a limited number of members and academicians and, as European anesthesiology grew, was perceived by many to be an exclusive and elitist organization. In 1992, the ESA was formed and was open to everyone. Its chief aims were to conduct an annual Euroanaesthesia meeting to replace the European Congress, which had formerly run on a 4-year cycle alternating with the World Congress, and to support educational and research activities by awarding grants and fellowships. Whereas the ESA was concerned with the practice of clinical anesthesia and supporting its membership, the EAA had developed formal initiatives such as the EDAIC, the *European Journal of Anaesthesiology (EJA)*, and a system of hospital visiting and accreditation training in conjunction with the EBA.

The fourth organization that existed at that time was the Confederation of European National Societies of Anaesthesiology (CENSA), which was effectively the European section of the WFSA.

For some years, the roles of all the various organizations made it increasingly necessary for an individual anesthesiologist to be a member of more than one body to participate in and benefit from all the variety of activities. As a result, in 1998 a decision was made to amalgamate the former ESA, EAA, and CENSA into one organization. A temporary organization, the European Federation of Anaesthesiologists, was established in 2001, under which amalgamation was successfully achieved. Subsequently, the new European Society of Anaesthesiology, which now represents every anesthesiologist in Europe, was launched in January 2005 in its interim form before becoming fully established in January 2006. Moreover, because the formal, declared responsibilities of the parent organizations were essentially different with little overlap between them, a strong and comprehensive organization was established right from the start. Under this new organizational structure, CENSA became the ESA National Anaesthesiology Societies Committee, now ESA National. Each country has a number of delegates to ESA National, depending on the number of members in its national society. This body constitutes the European Regional Section of the WFSA.

The ESA National provides a comprehensive range of activities to support European anesthesiology, primarily aimed at sustaining and enhancing the safety, efficacy, and quality of care of patients through publication of the EJA and the Euroanaesthesia organization and other

meetings; it supports the interests of its members and facilitates the exchange and dissemination of information related to anesthesiology, critical care, pain, and emergency medicine. It encourages research and scientific progress by conducting academic meetings and clinical studies, by awarding grants and fellowships, and by raising and harmonizing the standards of anesthesiology. This is achieved by delivering education, training, continuous medical education, developing guidelines and accreditation of anesthesiologists through educational programs, the EDAIC, and in-service training examinations, as well as through the HVTAP run jointly with EBA. The whole structure of the new ESA is currently undergoing a major revision, including changes in the by-laws.

European Journal of Anesthesiology. The EJA is the official journal of the ESA and is distributed to all ESA members. It is published monthly and is owned by the ESA. It is also the official journal of EBA. A group of editors is responsible for the content of the journal. The EJA publishes original work of high scientific quality. Preference is given to experimental work or clinical observation in humans and to laboratory work of clinical relevance. The journal also publishes commissioned reviews by an authority in a field of interest to those working in anesthesiology, pain, or critical care. Editorials, commentaries, book reviews, news, and notices are also included. In addition, the ESA publishes a newsletter four times per year, separately from the EJA. This newsletter contains items of interest to ESA members as well as information and formal announcements.

India (Deepak K. Tempe)

Since its inception in 1947, the ISA has grown from 19 to nearly 21,000 members in 2014. The South Asian Confederation of Anaesthesiologists with member countries India, Bangladesh, Sri Lanka, Pakistan, Nepal, and Maldives was formed in November 1991. Currently, there are also separate Indian associations of cardiothoracic anesthesia and neuroanesthesia. The Indian Association of Cardiovascular and Thoracic Anesthesiologists (IACTA) is 16 years old and holds an annual meeting. The IACTA awards fellowships in cardiac anesthesia after holding an exit examination of eligible candidates. Furthermore, a fellowship program in TEE has been initiated in collaboration with the Indian Academy of Echocardiography. Since 2007, a national workshop on perioperative TEE has been organized for cardiac anesthetists to learn this technique, which is now readily available in most cardiac centers. The IACTA also publishes the journal *Annals of Cardiac Anaesthesia,* which is now in its fifteenth year of publication. It has the distinction of being included in MEDLINE and being the first Indian journal in anesthesia to be indexed in the National Library of Medicine and has been followed by the *Indian Journal of Anaesthesia* and the *Journal of Anaesthesiology and Clinical Pharmacology*. In addition, a number of societies have been formed, including ones for the study of pain (founded in 1984), for critical care medicine (founded in 1992), and for obstetrics anesthesia (founded in 2005). Asian societies in cardiac anesthesia, neuroanesthesia, and pediatric anesthesia have also been formed.

Professional and research activities in India have increased with the formation of subspecialty groups in the country. Among them, cardiac anesthesia has made a particular mark. An article published in the *Journal of Cardiothoracic and Vascular Anesthesia* has highlighted that India is second to the United States and leads the rest of the world in number of related publications during the last decade. Although there were fewer original articles published in India, the authors concluded that the research activities from India cannot be ignored.[47]

Japan (Naoyuki Hirata and Michiaki Yamakage)

As mentioned before, the JSA was established in 1954, and it has held annual meetings every year since then. Subcommittees on anesthesiology, focusing on cardiovascular anesthesia, pediatrics, obstetrics, geriatrics, monitoring and equipment, nerve blocks, research, and education have been established. As of 2012, the JSA has 5450 certified anesthesiologists and 3341 supervisors. Most Japanese anesthesiologists regularly interact with colleagues internationally and in Japan to maintain their own expertise, and more than 250 Japanese anesthesiologists attend the annual meeting of the ASA every year.

In addition, the JSA has published the *Journal of Anesthesia* since 1987, and it has been indexed in the National Library of Medicine, including the MEDLINE database. Numerous manuscripts have been submitted from many countries. The number of articles published annually has increased to nearly 180.

The Middle East (Anis Baraka and Fouad Salim Haddad)

Most anesthesiologists in the Middle East keep in close contact with developments in anesthesia throughout the world by attending national and international congresses, subscribing to various international anesthesia journals, and maintaining worldwide friendships. Some anesthesiologists in the Middle East, including those who have emigrated abroad, have become leaders in the specialty and have made original contributions in the fields of muscle relaxants,[48-50] semi-open systems, obstetrics,[51] pediatric anesthesia,[52,53] and the pathophysiology of open heart surgery.[54] In addition, the Middle East actively contributes to publications. The *Middle East Journal of Anesthesiology,* which is published by the Department of Anesthesiology at the American University of Beirut, is widely distributed all over the world and is recognized by Index Medicus (Fig. 2-12).

Russia (Yury S. Polushin and Olga N. Afonin)

With the exception of a few medical centers, most anesthesiologists have to practice their art of extremely invasive and possibly dangerous science without sufficient monitoring. Pulse oximeters, gas analyzers, and capnographs are still a luxury in many medical centers. Medical science is again government financed, but it is often still dependent on the good will of the physicians who carve out time for research from their private lives. Russian anesthesiologists, as well as medics in other specialties, have been raising their concerns to the government. The Ministry of Health has accepted a new national program

Figure 2-12. Cover of the *Middle East Journal of Anesthesiology*.

for improvement in medical services, but it will take dramatic measures and significant investments in the health of Russian citizens for the country to achieve the goal of a safe and effective health care system in compliance with international standards. Statistics and the experience of multiple countries prove that the huge initial investments are returned as improvements in population health as medical and illness-related costs decrease. It would be gratifying to see Russia, the country that contributed so much to the growth and development of medicine and anesthesiology, return to the international scene as a partner in health promotion in all forms of medical science and art.

Southeast Asia (Florian R. Nuevo)

Two pioneering anesthesiologists, Professor Quintin J. Gomez of the Philippines and Dr. Saywan Lim of Malaysia, conceived the Confederation of ASEAN Societies of Anesthesiologists (CASA) in Kuala Lumpur in September 1974 during a meeting after the Fourth Asian Australasian Congress of Anaesthesiologists, a regional congress of the WFSA. The first ASEAN Congress of Anaesthesiologists was held in December 1979 in Manila, Philippines, under the leadership of Professor Gomez, who was then the incumbent president of the WFSA (1976-1980).

The main objective of CASA is to enhance and promote the specialty of anesthesiology in the region by hosting biennial congresses of anesthesia called the ASEAN Congress of Anaesthesiologists. These congresses serve as a venue for ASEAN anesthesiologists to meet experts from the United States and Europe, as well as other international anesthesia leaders, and to learn current practices in anesthesia from them. The congresses also inspire trainees and younger anesthesiologists in Southeast Asia to present their clinical trials and modest research activity and to participate in scientific activities as resource speakers or workshop facilitators.

Currently, CASA member societies conduct clinical research activities in anesthesia, but there is much room for improvement. Most research studies involve clinical drug trials funded by pharmaceutical companies. There is a paucity of published papers in peer-reviewed anesthesiology. What is also lacking is translating the research activities into well-written research papers. The *ASEAN Journal of Anesthesiology* serves as a venue to publish all of these research endeavors in the region.

Over time, the objectives of CASA have grown. The group has strived to promote closer ties among member societies, to enhance the image of the specialty in the region, and to upgrade the specialty through the exchange of information between local and international experts in anesthesia. CASA also supports interacting with other anesthesia regional sections such as the South Asian Association for Regional Cooperation, which represents Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka.

Many anesthesia subspecialty organizations have been created. To date, these include the Obstetric Anesthesia Society for Asian and Oceania (OASAO), Asian Society for Pediatric Anesthesiologists, ASCA, Asian Oceanic Society for Regional Anesthesia (AOSRA), Asian Society for Neuroanesthesia and Critical Care (ASNACC), and ASEAPS. Indeed, through CASA and these subspecialty groups, a wealth of information is paving the way to upgrade and develop the practice of anesthesia and the anesthesiologists themselves.

Despite threats of terrorism and the risks of epidemics such as avian flu and severe acute respiratory syndrome (SARS), the ASEAN confederation has persisted in hosting its biennial congress. Their leaders have been inspired to step up these academic activities, and CASA members take turns, with much enthusiasm and camaraderie, in hosting these meetings. Attendance has grown from 400 to almost 1000 anesthesiologists coming from ASEAN and non-ASEAN countries, such as Japan, Korea, China, Saudi Arabia, Mongolia, Canada, and the Middle East. The faculty of speakers includes local ASEAN and international anesthesia experts from the United States, Europe, Canada, Australia, and New Zealand, some of whom were supported by the WFSA, by industry, by respective anesthesia societies, and by the faculty themselves.

SAFETY AND MEDICOLEGAL INITIATIVES IN THE REGION

Chile/South America (Guillermo Lema)

Medicolegal issues and increased concern from patients have been behind the adoption of accreditation requirements. It is encouraging that most anesthesiologists are willing to obtain certification; clinics and hospitals are

also requiring certification for physicians to work in these institutions.

Furthermore, the medical community recognizes and has adopted certification of specialties, accreditation of both national and international public and private hospitals, the need for full and proper communication with patients and relatives, the creation of rules for different procedures, and the requirement for written consent. Disclosure of morbidity and mortality has also helped patients to be aware of the medical care to be received.

China (Yuguang Huang)

Anesthesia is undoubtedly a high-risk profession. The uneven development across the country in the economy and in clinical medicine in different areas has resulted in even larger differences in anesthesia safety. Therefore, well-established quality assurance systems and a culture that cultivates safety are keys to achieving higher safety coefficients. The National Anaesthesiology Quality Assurance Centre, which was established by the MOH in 2011, performed a series of measures for safety control, including designing standardized sheets for the intraoperative anesthesia record, encouraging surgical time out procedures, and constructing an incident report system. The National Anaesthesiology Quality Assurance and Assessment Standards were also established by the MOH in June 2012. Branches of the Quality Assurance Centre have also been established in each province throughout China, composing a nationwide network for quality and safety.

Europe (Lars I. Eriksson and Jannicke Mellin-Olsen)

Helsinki Declaration on Patient Safety in Anaesthesiology. Anesthesiologists are in a unique position to safeguard patients' best interests whenever they are at their most vulnerable, be it in the operating room, the critical care unit, in need of critical emergency care, or when suffering great pain. It is estimated that 200,000 patients in Europe die every year from complications due to surgical procedures. The EBA worked closely with the ESA and other bodies to develop the Helsinki Declaration on Patient Safety in Anaesthesiology (Declaration), which was launched in 2010.[55] The text emphasizes the roles of anesthesiologists, patients, clinical partners, funders of health care, and partners in drug and technical industries. It highlights the role of education, training, and human factors. The principal requirements to obtain the goals are listed, and anyone involved in health care was invited to sign. Representatives from the EBA, ESA, health politicians, patients' organizations, the WHO, WFSA, UEMS, and others participated in the launch. The declaration was immediately signed by most European anesthesiology societies. It has since been translated to several languages and is used actively to promote patient safety in a majority of European countries. EBA and ESA have installed a Patient Safety Task Force that is working on the follow-up and the implementation of the declaration.

An unexpected consequence of the declaration was the attention it has received across the world. It has been signed by the countries in CASA and the by those in Latin America. The South Asian Societies signed a similar Bangalore Declaration in 2011, and the Australian, New Zealand, and Canadian Societies also support the intention of the declaration. This support implies movement toward a global effort to improve patient safety.

Another program that is linked to patient safety is the Lifebox project, initiated by the WFSA, the Association of Anaesthetists of Great Britain and Ireland, and the Harvard School of Public Health to provide pulse oximeters to every operating room in the world, including education, training, and peer support. The goal is to close the pulse oximetry gap. The ESA and other European anesthesiology bodies endorse the program.

India (Deepak K. Tempe)

Medicolegal Aspects of Anesthesia Practice in India. As in most other countries, it is unlawful to practice medicine in India without proper registration with the State Medical Council or Medical Council of India.[56] The medical profession is regarded as noble in India, and at one time doctors were considered as having an integrity beyond doubt (next to God). This situation existed before 1980 when patients and the public accepted without question the outcome of their illness. However, this perspective has gradually changed as a result of the increased awareness brought about by consumer and social organizations and the media.[57] The gross commercialization of the medical profession coupled with the abject failure to self-regulate has also been responsible.

The Consumer Protection Act (CPA) of 1986 addresses the consumer grievances arising from the service providers. Section 2(1)(0) of the CPA defines the word *service,* and Section 2(1)(d) defines *consumer* (i.e., persons availing such services). Initially, it was controversial whether the medical practitioner could be regarded as rendering a service.[58,59] However in 1995, the Supreme Court judgment in the Indian Medical Association (IMA) *v* V. Shantha case clarified that service rendered to a patient by a medical practitioner (except where the doctor renders service free of charge to every patient or under a contract of personal service), by way of consultation, diagnosis and treatment, both medicinal and surgical, would fall within the ambit of "service" as defined in section 2(1)(0) of the act. Furthermore, any hospital, whether government or private, that collects charges from all or some of its patients is covered by the CPA. In these hospitals, even patients treated free of charge are entitled to go to the consumer courts for compensation for deficiency of service.[60] Likewise, anesthesiologists, even if not hired by the patient directly (i.e., hired by surgeon, private clinic, or hospital), are liable to pay compensation under CPA.[61]

Consequently, most of the cases relating to medical negligence go to the consumer courts, because these courts are inexpensive and provide a speedy disposal of cases. Depending on the value of services and compensation claimed, complaints can be filed with the district, state, or national commission.

The CPA created significant discomfort within the medical fraternity in India with initial protests from medical professionals and the IMA, as well as several heated and emotional debates among the senior doctors. Eventually, they came to the realization that the act covers the medical profession and is here to stay.[57]

As in many other countries, insurance companies in India consider anesthesiology a high-risk specialty. In addition, the public is still relatively unfamiliar and unaware about anesthetic risks. As a result, anesthetic complications are not as readily acceptable as surgical complications are. Many times the complaint is lodged against the treating doctor (generally the surgeon) or the hospital, and the anesthesiologist is subsequently made the party. Indian society is more aware of patient's rights as seen from the recent spurt in litigations concerning medical professionals or establishment liability, claiming redress for the suffering caused by medical negligence, vitiated consent, or breach of confidentiality arising out of doctor-patient relationships.[62] Slowly, people are also realizing that it is not easy to obtain compensation through the court unless there is strong evidence of negligence.[63]

Establishing medical negligence and successful litigation requires that four criteria be satisfied. First, the claimant must be owed a duty of care. Second, a breach of that duty of care by failure to provide reasonable standard of care should be established. Third, the claimant should have suffered damages resulting from the actions of the anesthesiologist. Fourth, a reasonably close causal relationship must exist between the anesthesiologist's actions and the resultant injury.[64] These criteria are similar to the ones followed in the Western world.[65] Therefore, it can be considered that following the Bolam principle can be the defense for the anesthesiologist. According to the Bolam principle, the doctor is not liable for his diagnosis, treatment, or refusal to give information to the patient, if he follows a responsible body of medical opinion.[66] This principle poses a significant problem in India, because the guidelines in most of the anesthetic areas are nonexistent. Barring the minimal monitoring standards, the health authorities or the ISA have no recommendations or practice guidelines for dealing with different clinical problems. In this respect, the ICA is expected to play a big role. It has the responsibility of formulating guidelines for the various anesthetic practice issues. However, this task is challenging and daunting because of the broad variations in the facilities and services that exist in this country.

Currently, most anesthesiologists in the country tend to follow the British or American guidelines. Unfortunately, these guidelines may not be applicable in a large number of clinical circumstances in India, and following them as a benchmark of standard of care is not without problems. First, it is important to ensure that clinicians are not following outdated ideas or principles. Second, acceptable clinical practice continues to evolve rapidly, necessitating frequent updates. Furthermore, the professional standards given in the guidelines might be insufficiently comprehensive or too vague, allowing for subjective interpretation of management strategies in a given clinical scenario. Because of the absence of guidelines as well as the equivocation of the guidelines (even if they were present), the processing of a negligence claim is predominantly opinion-based in India. Opinion on negligence claims is generally sought from the regional medical councils, which have a panel of experts to investigate a particular case. This is not to say that the ICA should not strive to prepare the guidelines; on the contrary, the need for guidelines is clear, at least in cases of common clinical scenarios, such as cesarean section, laparoscopic surgery, or cardiac patient undergoing noncardiac surgery.

The state medical councils have taken a lead in such matters. They have the responsibility of ensuring that no unqualified person practices modern medicine and of providing the expert opinion in complaints of negligence against doctors. For example, the 1997 Delhi Medical Council (DMC) act empowers this body to initiate disciplinary action or award compensation and to take action against frivolous complaints.[67] Currently, it has become a custom for the police and the criminal courts to send all complaints to the DMC for an expert opinion in the matter. The consumer courts, on the other hand, may or may not send all the matters for expert opinion; however, barring obvious cases in which the principle of *res ipsa loquitur,* meaning "the thing itself speaks," applies (e.g., artery forceps left in the abdomen during an operation), the expert opinion is generally sought. The matter may be referred to DMC or any other medical college for this purpose. In addition, the DMC receives complaints directly.

The DMC has an executive committee (consisting of executive members of the DMC and one or two experts in the field) that acts as a screening committee, and in case it finds any prima facie evidence, the matter is referred to the disciplinary committee. The disciplinary committee includes a member of the legislative assembly (nominated by the speaker), a legal expert, an eminent public person nominated by the government, an eminent medical specialist in the relevant specialty to which the complaint pertains, and a member nominated by the Delhi Medical Association with a minimum 10 years' standing.[67] The disciplinary committee is empowered to pass an order that can initiate disciplinary action. However, all decisions of the executive committee and the disciplinary committee need approval from the council, which consists of 20 council members. Table 2-4 shows the number of cases against doctors and anesthesiologists during the last 5 years in the state of Delhi.[68] It was observed that most of the complaints were related to relatively trivial matters against the hospital, such as overcharging, performing unnecessary investigations, practitioners practicing without valid registration, a laboratory submitting a wrong report, issuing of false medical certificates, and negligence in medical care leading to nonfatal harm to patients. A few cases were brought directly against

TABLE 2-4 NUMBER OF LITIGATIONS AGAINST HOSPITALS AND DOCTORS IN DELHI, 2007-2011

Year	Total complaints	Against anesthesiologists	Against hospital or treating doctor where anesthesiologist was made party subsequently
2007	105	0	7
2008	79	1	7
2009	98	0	8
2010	199	1	6
2011	107	0	10

anesthesiologists, but usually, anesthesiologists are made a party to a complaint against the hospital or the treating doctor (generally surgeons).

One unusual situation in which the anesthesiologist may be held liable is the use of local anesthetics by the surgeon for some minor surgical procedure, such as debridement or suturing. Often local anesthetics are used by surgeons and other practitioners for this purpose in the absence of an anesthesiologist. At times, a reaction to the local anesthetic can lead to serious consequences and because the anesthetist is often called for resuscitation and further management, he or she is also made a party if a complaint is filed by the patient's relatives. Thus, the anesthesiologist can be named in a legal suit even if he or she did not administer the local anesthetic. Likewise, use of ketamine and sometimes propofol is practiced by some practitioners in the absence of an anesthesiologist. Although such a practice is endorsed by some,[69] it is believed that the presence of an anesthetist is mandatory.[70] This may be hard to implement in India because of a shortage of anesthetists. This is just one of the many challenging issues the ICA has to address and resolve.

In India, it is accepted that there can be more than one way of dealing with a problem, and an anesthesiologist has the discretion of choosing the treatment, with broader discretion in emergency cases. The National Commission and the Supreme Court have held that the doctor should have a reasonable degree of skill and knowledge and exercise a reasonable degree of care. However, the doctor is not liable for negligence simply because someone else of better skill or knowledge would have prescribed a different treatment.[71] Thus, mere allegation of negligence is not enough; it is for the complainant to prove the negligence or deficiency in service by adducing expert evidence or opinion, and this fact is to be proved beyond all reasonable doubt.[72,73]

Frivolous complaints against doctors have increased in India, especially after the CPA was enacted. The courts recognize this.[74,75] The court has no sympathy for doctors who are negligent, but to avoid unnecessary harassment of doctors, the court has directed that whenever a complaint is received against a doctor or hospital by the consumer forum (district, state, or national) or by the criminal court, before issuing notice to the doctor or hospital against whom the complaint was made, the consumer forum or criminal court should first refer the matter to a competent doctor or committee of doctors specialized in the field to which the medical negligence is attributed. Only after that doctor or the committee reports that there is a prima facie case of medical negligence should a notice be issued to the concerned doctor or hospital, or both. The court has further directed that police cannot routinely arrest a doctor simply because a charge has been brought against him or her. Instead, the investigating officer should, before proceeding against the accused doctor, obtain an independent and competent medical opinion. Such an approach by the judiciary has come as a significant relief for doctors.

The effect of the CPA is evident on anesthesia practice in India. It is imperative that anesthesiologists have informed consent, be vigilant, keep up to date on the guidelines and their knowledge in the discipline, and maintain proper record keeping. Accurate and adequate record keeping can be their defense in cases of litigation. Under Indian law, a case can be filed with the consumer courts up to 2 years after the occurrence of an incident. Thus, there may be a considerable time lapse between the occurrence of an incident and the hearing of a court case. Therefore, the anesthetic record should be as accurate, complete, and neat as possible. In addition, developing good patient relationships is considered another important factor to avoid litigation.

It is imperative that ISA and ICA issue guidelines, recommendations, and protocols be followed in different clinical situations to help the judiciary apply the Bolam's principle to the facts collected in the investigation of a particular case.

Southeast Asia (Florian R. Nuevo)

As in the United States, medical malpractice lawsuits are increasing in the ASEAN region. The threat of malpractice has pressed the need for high standards of monitoring as a mandatory requirement, because some hospitals in low- to middle-income countries cannot afford to procure the necessary equipment and complete array of anesthetics and related medications.

The region's maldistribution of anesthesiologists, the poverty of some societies, the unavailability of essential drugs, and the lack of the necessary infrastructure or resources further aggravate the problem of patient safety.

Although remarkable improvements have occurred in anesthesia education and the development of life-saving skills, perioperative anesthesia-related morbidities still occur. There is growing awareness of the influence human factors and anesthesia nontechnical skills have on patient outcomes. All these factors should be subjects of discussion in anesthesia training programs and postgraduate medical education. Cultural sensitivities must also be underscored to find effective solutions to our problems.

Fortunately, the tides of change are continual, and almost all national anesthesia societies have adopted guidelines or standards for safe anesthesia practice. Credit must be given to Malaysia for its pioneering efforts establishing a national medical audit system. This model is currently used in Singapore and Thailand, as well. Thailand has developed its own national anesthesia incident reporting program and, through ASEAN anesthesia leadership, other ASEAN anesthesia societies are encouraged to duplicate this program.

The WHO Safe Surgery Saves Lives initiatives have helped to arouse interest in the promotion of patient safety. Anesthesia patient safety is now recognized as a public health concern because of the morbidities and mortalities related to surgery and anesthesia.

The Helsinki Declaration on Patient Safety in Anesthesiology further awakened the region with more practical guidelines. These have gained the full support of members of CASA. Many safety initiatives are now underway.

Thus, the current challenge is the earnest and sincere implementation and sustainability of all these safety initiatives. Steadfast leadership is necessary to sustain these patient safety programs. Collaboration among all

stakeholders is essential to bridge the existing gaps in patient safety.

CONCLUSION

As demonstrated in this chapter, anesthesiology as a discipline and a profession has grown dramatically around the world. Differences in the rate of growth and scope of practice exist for a variety of reasons, largely because of disparities in resources and socioeconomic and political factors. Nevertheless, regardless of country of residence, patients receiving anesthesia can feel much safer today than even 20 or 30 years ago in most countries (exception exist, as indicated in this chapter). Providing safe anesthesia requires knowledge, resources, and adequate numbers of trained anesthesia personnel. Over the previous decades, adequate resources for health care including anesthesia are increasingly available. However, some areas of the world still do not have adequate training or resources; Sub-Saharan Africa is an example. Fortunately, international organizations are attempting to address these deficiencies.

On the positive side, some of the most powerful advances are the spread of knowledge, professional integrity, curiosity, and the utmost desire to practice anesthesiology at the highest possible level. Especially with the widespread expansion of information technology anesthesiologists can quickly learn of the advances of their colleagues worldwide and better understand and respond to the needs of their patients.

So where do we go from here? Some authorities suggest taking advantage of the latest advances to further the interconnectedness of the profession, such as conducting more in-depth comparisons of the effectiveness of various techniques from country to country and engaging in more joint research. Others believe that such comparisons would serve no useful purpose, given the evident disparities in resources and different approaches to care. The editor has dreamed of the day that anesthesiologists worldwide would form global think tanks to ask and answer the most important questions to advance our intellectual foundations and benefit society. As noted in the opening paragraph, the purpose of this chapter is not to invite comparisons or highlight differences in the practice of anesthesiology around the world, but rather to encourage and invite anesthesiologists globally to keep talking to each other. The editor was thrilled and honored that his invitation to contribute to this chapter has resulted in so many interesting contributions from leaders of anesthesia worldwide. When viewed together, the journey of anesthesiology has been an amazing story worldwide.

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Chapter 3

Perioperative Management

NEAL H. COHEN

Key Points

- The practice of anesthesia has expanded beyond the traditional operating room environment to other sites throughout the hospital and ambulatory facilities. Concurrently, anesthesia has evolved to include acute and chronic pain management, critical care medicine, palliative care, and sleep medicine.
- The expanded scope of anesthesiology creates opportunities for anesthesiologists to take on a broader role in perioperative care, providing management of patients through the continuum of the perioperative period and transition to outpatient care.
- Unfortunately, the costs of hospital care and perioperative care continue to escalate. In response to the increasing costs and emphasis on quality and patient safety, payers are modifying payment methodologies to better align goals of care. Both government (e.g., Medicare) and private payers (e.g., insurance companies) are implementing bundled payment and other payment methods designed to transfer the risk associated with management of complications and preventable harm to providers (e.g., hospitals and physicians).
- To provide optimal perioperative care under these circumstances requires more collaborative interactions among providers and new models of care. Many delivery models have been implemented with varying outcomes. Clarifying roles and responsibilities of the surgeon, anesthesiologist, and other providers is critical to delivering high-quality cost-effective care. Although nonanesthesiologists, including hospitalists, can be very helpful in addressing some clinical needs for the surgical patients, anesthesiologists are well positioned to take a more prominent role in overall perioperative management, benefiting patients, optimizing quality and outcomes of care, and improving efficiency during and after surgical procedures.
- Accomplishing these goals requires reevaluation of overall perioperative management strategies, including preoperative evaluation, intraoperative care, and postoperative management. These goals also depend on accessibility to clinical and financial data and personnel with the skills to analyze the information for delivery of optimal care while improving efficiencies.
- Many models of perioperative management have been implemented with varying success. The perioperative surgical home (PSH) is an example of a new model that might have great benefit for selected patient populations, aligning patient's, provider's, hospital's, and payer's goals, and significantly improving perioperative care.

Fifty years ago, anesthesia care was dominated by intraoperative management, and most clinical income came from services related to surgical care. Gradually, the scope of anesthesia broadened beyond the intraoperative period to include preoperative evaluation, intraoperative management, and postoperative assessment to determine whether the patient suffered any consequences of anesthesia care. Although this model of care—and the associated payment methodology—was an appropriate model of anesthesia care in the past, today the changing needs of the patient, complexity of care, and the role of the various health care providers mandate that we define alternative models for perioperative management to optimize clinical outcomes.

This chapter reviews the changing and expanding focus of the anesthesia practice. Management of clinical care throughout the perioperative period includes preoperative assessment and management to optimize outcomes after procedures, intraoperative care, and postoperative strategies. Thus, the anesthesiologist has an expanded scope of practice and participates more broadly in all aspects of care, with the overall result of improving outcomes and reducing costs.

The impetus for expansion of the scope of anesthesia practice comes from multiple perspectives. First and foremost is the commitment to provide patients with high-quality and safe care that fulfills their goals. To do so requires a broader focus on the overall perioperative course rather than a scope of care that is limited to the intraoperative and immediate postoperative care periods.

A second and equally important goal toward which the anesthesiologist plays an integral role is the increasing emphasis on evidence-based practice, limiting unnecessary or redundant services, and providing more efficient care, particularly in the immediate perioperative period. There is no question that the high costs of inpatient services, particularly for patients with underlying comorbidities who undergo complex surgical procedures, contribute to escalating overall health care expenditures.[1] Although many of these services are important to ensure that the patient is adequately prepared for anesthesia and surgery, some aspects of care may be based on tradition rather than demonstrated benefit. At the same time, the evolution and expansion of anesthesia practice have created many new opportunities for anesthesiologists to participate in perioperative care beyond the immediate postoperative period—and to define standards of care for selected patient populations. Some anesthesiologists are integral members of teams of providers who care for selected surgical patient populations, and they collaborate with surgeons to develop clinical pathways and identify ways to improve preoperative care as well as intraoperative and postoperative management strategies that enhance outcomes. For example, transplant anesthesiologists (also see Chapter 74) are often involved in discussions about patient selection, preoperative management, and transitions of care from the operating room to postoperative period. As a result of these efforts, many transplant patients who previously required postoperative care in the intensive care unit (ICU) can now bypass the ICU and have reduced hospital lengths of stay.[2] Similar outcomes have been documented for patients who have anesthesiologists participate in their perioperative management for cardiac surgery (also see Chapter 67), pediatric surgery (also see Chapter 93), neurosurgery (also see Chapter 70), and other subspecialties. In each of these examples, collaboration among the surgeons, anesthesiologists, and the overall team of providers both within and beyond the operating room environment is critical to realizing improved outcomes and reduced costs of care.

The role of the anesthesiologist in perioperative management also includes the subspecialties of pain medicine and critical care. Pain management strategies have significant positive impact on the care of patients with both acute and chronic pain (also see Chapters 64, 96, and 98). More rational approaches to perioperative pain management, particularly for patients with longstanding chronic pain, have had positive impact on perioperative outcomes and, in many cases, reduced lengths of stay in hospitals and improved patient satisfaction.[3-5] Similarly, critical care anesthesiologists play a large role in improving perioperative management of patients requiring ICU care. The critical care physician's value in improving ICU utilization, reducing complications of mechanical ventilation, providing early diagnosis and treatment of sepsis, and improving management strategies for patients with renal dysfunction is well documented[6-9] (see Chapters 96, 101-103, and 105). Although not frequently addressed by anesthesiologists, postdischarge care needs are often related to perioperative management; anesthesiologists can have a meaningful role in addressing some of these significant costs of care and the related issues that lead to dissatisfied patients and providers.

A third area of concern that has taken on greater importance over the past decade is the rising cost of health care in general and perioperative care in particular. Advances in technology for both anesthesiologists and surgeons have made it possible for patients who previously were denied surgery because of underlying chronic medical conditions, anesthesia risk, or limited surgical options to undergo often complex and costly procedures that may require prolonged postoperative and rehabilitative care. In addition to surgery costs, additional costs (often significant) are associated with complications of care, postdischarge care, and readmissions.[10] The acknowledgment of these frequently underestimated costs is having a major impact on models of perioperative care delivery and payment methodologies. For example, in the United States, both government and private payers have raised concerns about the costs associated with managing complications of care, some of which are relevant to anesthetic management. These payers have been reducing payment for costs associated with complications and denying payment for costs associated with readmissions.[11,12] Anesthetic management has implications for the occurrence of some of these complications, as well as for the need for prolonged ICU stays and other clinical outcomes. For example, central line infections, ventilator-associated pneumonia, decubitus ulcers, and renal failure may be either directly or indirectly related to perioperative (anesthetic) management. Implementing strategies to reduce these complications has been very successful; a more coordinated approach to perioperative management by the anesthesiologists can have significant positive impact on both clinical care and costs.

Another change that is having considerable impact on surgeon, anesthesiologist, and other provider relationships is the transition from fee-for-service (FFS) payment for clinical care to alternative bundled payment methodologies, such as providing a single payment for hospital care, physician services, and in some cases rehabilitation that is related to an episode of care or specific surgical procedure.[10] In the United States, FFS is still the most common payment methodology. Under this payment methodology, each provider receives compensation for the specific services provided to the patient. Payment is encounter based and does not encourage collaboration or coordination of care. Although the implications of FFS