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Perioperative Medicine

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KEY POINTS

- The practice of anesthesiology continues to evolve with health care for patients undergoing new and, in many cases, more complicated procedures in the operating room as well as minimally invasive or interventional procedures performed in other nonoperating room settings. With the rapid growth of nonoperating room anesthesia, traditional operating room anesthesia care no longer dominates most anesthesia practices.
- The number of anesthesia subspecialties has also increased to include pediatric, cardiothoracic, obstetric, neuroanesthesia, critical care medicine, acute and chronic pain management, palliative care, and sleep medicine. Anesthesiologists' skills and expertise in subspecialties have grown paralleling the respective surgical specialties.
- The diversity of anesthesiology skills and clinical capabilities has created opportunities for anesthesiologists to take advantage of the changing healthcare environment and assume a more expansive role in perioperative care in both hospital and nonhospital settings, providing management of patients through the continuum of the perioperative or periprocedural period, and extending to home care and other settings.
- With changes in healthcare delivery, anesthesiologists will have to not only reassess current practices, but also define ways to adapt to new models of care. New approaches to care, while exciting for the specialty will be challenging to implement. While expanding the scope of practice, anesthesiologists must also continue to fulfill the traditional operating room roles and maintain the commitment to safe and high-quality intraoperative anesthesia care.
- To successfully transition to these new models of practice, anesthesiologists must acquire a more comprehensive understanding of the economics of health care and the role their perioperative care has in determining costs of care, outcomes, quality, and safety.
- The electronic health record and access to big data can serve as valuable resources in identifying opportunities to advance care and improve quality. To use the electronic record effectively will require that anesthesiologists acquire skills in biomedical informatics and data sciences to advance perioperative care.
- Public and private insurers are implementing new payment models to replace traditional fee-for-service payment for clinical care. They are transitioning from fee-for-service to "value-based" payment methodologies that better align quality, costs, and goals of care. At the same time, both government (e.g., Medicare) and private payors (e.g., insurance companies) are implementing new alternative payment models including bundled (fixed) payment methodologies designed to transfer the financial risk from patients and payors to providers, both physicians and health systems. Anesthesiologists must understand these new payment models and how they will impact clinical management and compensation for anesthesia services, particularly as anesthesia services and perioperative medicine evolve.
- Providing optimal perioperative care in the current healthcare environment requires implementation of new and creative models of value-based care that encompass the patient's entire clinical course as well as development of new partnerships and collaborations with other providers across the healthcare system. Anesthesiologists are well positioned to take a more prominent role in perioperative management, integrating their understanding of the surgical and medical needs of patients during and after surgical procedures. Concurrently, other physicians, including hospitalists, are partnering with surgeons to optimize perioperative inpatient care. Collaboration with hospitalists, medical specialists, and others is critical to improving perioperative care and in clarifying the roles anesthesiologists can play in providing value-based perioperative care. For some patient populations, co-management agreements can be executed to coordinate perioperative care and optimize transitions through the continuum of care.
- A variety of models for perioperative medicine are being successfully adopted in the United States and other countries. The perioperative surgical home (PSH) and Enhanced Recovery After Surgery (ERAS) protocols are examples of new approaches to collaborative multidisciplinary care that have demonstrated significant benefit for a number of patient populations—aligning goals for patients, providers, hospitals, and payors.

Introduction

The primary focus of anesthesia practice has traditionally been on the intraoperative management of patients undergoing surgical procedures in hospitals or ambulatory settings. Over the past few decades, anesthesiologists have been acknowledged for the significant improvement in perioperative safety and quality.¹ As a result of advances in anesthesia care as well as surgical and diagnostic capabilities, anesthesia services have expanded to include a wide variety of hospital-based and ambulatory settings outside of the operating room. While the diversity of anesthesia services has expanded, the basic elements of anesthesia care remained relatively consistent—preoperative assessment, intraoperative management, and postoperative care provided to ensure safe transition through the perioperative period. With increasing subspecialty training opportunities and changes in healthcare delivery and payment, new opportunities have developed for anesthesiologists to assume a broader role in both perioperative care and management of patients in the operating room and beyond. At the same time, the increasing capabilities and high costs of health care, particularly in the United States, is undergoing significant pressure to improve quality and safety while delivering value-based care consistent with patient wishes.^{2,3} The changes create opportunities for anesthesia practices to evolve and for the role of anesthesiologists to extend beyond current clinical practices.

This chapter reviews the changes taking place in healthcare delivery and financing that create challenges and opportunities for anesthesiologists to expand their practices to incorporate concepts of perioperative medicine.

THE ANESTHESIOLOGIST AND PERIOPERATIVE MEDICINE

Perioperative medicine is an evolving field that focuses on optimizing the health and healthcare delivery of patients who will be undergoing surgery, and providing medical care for those patients following surgery. Anesthesiologists are well suited to advance their role as specialists in perioperative medicine and provide better care for surgical patients. New anesthetic techniques, monitoring capabilities, and evidence-based approaches to perioperative management have made anesthesia safer and improved the quality and safety of perioperative care.¹ Advances in surgery and development of minimally invasive techniques have had major impact on how anesthesia care is provided and expanded the locations in which anesthesia services are needed. At the same time, in part as a result of these changes, the patient population presenting for anesthesia has changed. Patients with significant underlying medical conditions who in the past were not considered candidates for surgery are now able to undergo complex surgical procedures successfully. These changes have had major impact on health systems, significantly increasing complexity and costs of care, while also putting pressure on healthcare resources including hospital bed capacity.^{4,5}

For anesthesiologists, the advances in care, diversity of patients requiring anesthesia services, and the high costs of care create both new opportunities and challenges. Most significant to the practice of anesthesia has been the expansion

in scope of clinical responsibilities in perioperative care of patients beyond the traditional operating room roles, and the need to improve operational efficiency in perioperative/periprocedural care and reduce costs. The challenges also provide the opportunity for anesthesiologists knowledgeable about operating room management to assume health system leadership roles and improve healthcare delivery for the surgical patients.

The change in scope of anesthesia practice is related to a number of different factors. The extension of anesthesia care to other inpatient and outpatient settings is based on management strategies and lessons learned in optimizing care in the operating room. The expansion of anesthesia services to interventional radiology, endoscopy, and cardiology suites has resulted in improved clinical management and, in some cases, better throughput.

Anesthesiologists have also modified clinical practices to optimize clinical care and improve efficiency. For example, preoperative assessment has been refined to improve clinical outcomes, but also reduce costs associated with laboratory testing and other preoperative testing that add no value.^{6,7} At the same time, anesthesiologists have had a greater role in optimizing patients prior to surgery. Preoperative *management* of patients with underlying medical conditions, including diabetes, cardiopulmonary disease, and renal insufficiency, has improved the perioperative course and minimized the likelihood of postoperative complications. In some cases consultation with other medical specialists is required, but for most patients, the anesthesiologist's role is critical to optimizing the patient's conditions preoperatively as they best understand the interplay of the various perioperative variables including patient factors, anesthesia, and surgical techniques. As a key aspect of optimal perioperative medicine, anesthesiologists are able to provide postoperative management, including critical care and pain management for many of these patients based on their individual preoperative risk assessment and intraoperative course. In many respects, these changes have redefined anesthesia to encompass perioperative medicine.⁸

The expansion of anesthesia training in multiple subspecialties, as well as critical care medicine and acute and chronic pain management, also provides advanced and diverse skills that allow anesthesiologists, in collaboration with the surgical specialists, to ensure a coordinated approach to perioperative management. As a result, many anesthesia subspecialists have successfully expanded their roles in perioperative care. As one example, transplant anesthesiologists (also see [Chapter 60](#)) are often involved in discussions about patient selection, preoperative optimization, and transitions of care from the operating room to the postoperative period. Based on the collaboration of anesthesiologists, transplant surgeons, and medical specialists, anesthesiologists participate in selection discussions to provide their perspective on the perioperative implications of transplantation. For many transplant services, collaboration with the anesthesiologists has resulted in reengineering of care. Many patients who previously required postoperative care in the intensive care unit (ICU) can now bypass the ICU and have reduced hospital lengths of stay.⁹ Similar outcomes have been documented for patients who have anesthesiologists participate in their perioperative management for cardiac surgery (also see [Chapter 54](#)), pediatric surgery

(also see Chapters 77-79), neurosurgery (also see [Chapter 57](#)), or 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.

Anesthesiologists with advanced training in pain medicine and critical care are able to facilitate and optimize perioperative management. Pain management strategies have significant positive impact on the care of patients with both acute and chronic pain (also see Chapters 51, 80, and 82). Employing multimodal approaches to perioperative pain management, particularly for patients with longstanding chronic pain, perioperative pain medicine teams have had positive impact on perioperative outcomes, including reduced need for opioid analgesics and in some cases shortened the length of stay in hospital and improved patient satisfaction.¹⁰⁻¹² Similarly, critical care anesthesiologists play a large role in improving perioperative management of patients requiring ICU care. The value of the critical care physician on ICU utilization in reducing complications of mechanical ventilation, providing early diagnosis and treatment of sepsis, and improved management strategies for patients with renal dysfunction are well documented (see Chapters in 80, 84, and 85).¹³⁻¹⁵

An equally important factor contributing to anesthesiologists assuming greater responsibility in perioperative management is related to their knowledge of the overall perioperative environment, its complexities, and associated high costs. Advances in anesthetic management have facilitated implementation of new surgical techniques and allowed patients previously considered poor risks to undergo complex surgical procedures with good outcomes. These advances in care have contributed to the escalating cost of health care, particularly in the United States.² Not only are the high costs specifically related to the procedure, there are often substantial additional costs associated with complications of care, postdischarge care, and readmissions.^{16,17} Anesthetic management has impact on costs of perioperative care, hospital length of stay, need for prolonged postoperative ICU stay, and other clinical outcomes. For example, intraoperative management can contribute to postoperative complications, such as pressure ulcers, central line infections, renal failure, aspiration and ventilator-associated pneumonia, cognitive dysfunction, and other complications. When these complications occur, hospitalizations are lengthy and rehabilitation (skilled nursing, physical, and rehabilitation services) needs are significant.

The need to address costs associated with managing complications of care is taking on greater importance. Over the past few years in the United States, government and private payors have raised concerns about the costs associated with managing complications of care, some of which are relevant to anesthetic management. These payors are reducing payment for costs associated with complications and denying payment for costs associated with readmissions.^{18,19} As part of perioperative medicine, anesthesiologists have to identify these perioperative risks and, when clinically appropriate, identify ways to modify management to improve outcomes and reduce costs.

Another factor that has precipitated a need to address perioperative care in a more coordinated manner is the

impact of changes in payment methods being implemented by both government and private payors as a way to control costs of care. In the United States, the primary method of payment to physicians remains fee based. While the implications of fee-for-service (FFS) payment methodology on quality of care and resource utilization are widely debated, FFS payment models are associated with overuse of some services, higher costs, and poor coordination of care.²⁰ In response to these issues, a number of alternative payment models (APMs) have been implemented including bundled payment methods and incentive-based payments associated with reduced costs of care and penalties when costs remain high. Under the Medicare Access and CHIP Reauthorization Act of 2015, Medicare has implemented a number of APMs and a Quality Payment Program that includes a Merit-Based Incentive Payment System (MIPS), each designed to compensate physicians for improving patient outcomes at reduced cost.²¹ Medicare is also encouraging development of accountable care organizations (ACOs) in which health systems assume clinical and financial responsibility for managing a population of patients, improving quality, and reducing overall costs.

These changes in care management and payment methodologies have significant impact on all physicians and health systems. They shift responsibility and risk to the providers and are forcing physicians and health systems to implement value-based care. Anesthesiologists are knowledgeable about the complexities associated with perioperative care and have the ability to manage many aspects of the care and systems needed to optimize it. Consequently, they can help define new models of care and extend their role and assume greater responsibility for managing the perioperative course of some patient populations. For example, if anesthesiologists can help reduce costs during the course of care for a surgical patient, they can benefit financially under bundled payment methodologies, shared savings plans, and when participating in ACOs. Although issues related to payment methodologies are very different from one country to another and are beyond the scope of this chapter, the goals and implications of these newer payment methodologies should be understood by all anesthesiologists, since they have significant implications on the practice of anesthesia and the role for the anesthesiologist in perioperative medicine broadly.

While anesthesiologists are well suited to positively impact perioperative care, anesthesiology departments will need to adjust their focus and priorities to be better engaged in perioperative medicine. When provided in a coordinated way, perioperative care is cost effective and improves outcomes.²² At the same time, the expansion of anesthesia practices, diversity of roles and responsibilities, and the subspecialization of anesthesia care have in some ways compromised the ability of anesthesiologists to fulfill their potential as perioperative providers. Compartmentalization of perioperative care and subspecialization have the risk of fragmenting care and undermining the development of a coordinated approach to perioperative management. At many hospitals, preoperative care is now provided in a dedicated preoperative evaluation clinic, physically separate from the operating room or other clinical sites. The evaluation is performed at some time prior to the surgical procedure; communication about the patient's status and

clinical plans is most often done electronically with no face-to-face dialog or communication with the anesthesiologist who will deliver care during the procedure. Operating room care is provided by an anesthesiologist either personally or as part of the anesthesia care team model. Postoperative management—including care in the postanesthesia care unit, pain management, and ICU care—is often provided by another set of care providers. Perioperative medicine requires collaboration among all anesthesia providers, incorporating the knowledge and skills of each of the participants, including those providing preoperative management, intraoperative care, critical care, pain management, and so on. As much as each of the providers is critical to the care of the patient, the coordination of care among the anesthesiologists as a group is also a critical element in optimizing care, understanding and fulfilling the patient's goals for care, and improving efficiencies.

Perioperative Management

Throughout this text, the role of the anesthesiologist in various aspects of perioperative management is discussed. Each component is critically important to the quality, safety, and costs of care. The overall approach to care from the time a case is scheduled until the patient has recovered from anesthesia and surgery and resumed normal activities should be of concern to the anesthesiologist. Just as anesthesia as a specialty is acknowledged for advances in safety and quality in the intraoperative case, it should extend its focus and responsibility to the entire perioperative period—coordinating assessment, management, and responsibilities with the surgeons, hospitalists, other physicians, and nurses. By optimizing each of them independently and then coordinating the care across the continuum, the benefits of providing perioperative medicine will be achieved—with improved clinical outcomes, safer care, and reduced costs.

PREOPERATIVE ASSESSMENT AND MANAGEMENT

Chapter 31 emphasizes the changing patient needs and role of the anesthesiologist with respect to preoperative assessment and management. The chapter provides a more comprehensive discussion. To summarize current practices, for most healthy patients, a formal preoperative assessment is usually not required.^{6,7} In fact, anesthesia providers have been able to reduce preoperative testing and other costs through the implementation of evidence-based protocols to standardize preoperative management for many patients.⁷ Rather than requiring a preoperative visit, laboratory testing, and radiologic studies, most patients now have a phone consultation, often performed by a nurse practitioner to assess preoperative status and perioperative needs, and to address a patient's questions or concerns. For other patients, particularly those with underlying medical conditions or complex comorbidities, a more comprehensive evaluation and preoperative management and optimization of underlying conditions may be required.²³ For this subset of complex patients, preoperative assessment and management are an integral part

of the continuum of perioperative care for which the anesthesiologist has a significant role. In some cases, additional diagnostic studies, such as an echocardiogram or focused pulmonary function studies, may be helpful in determining how best to manage a patient during the perioperative period. In this situation, interpretation of the studies may be done in coordination with a consultant or physician who has provided care to the patient preoperatively and who will resume care after the procedure is beneficial. The preoperative anesthesiologist may require a formal consultation with another specialist, such as a cardiologist, nephrologist, or pulmonary medicine physician, although these are needed for only a select few patients. For those patients with significant underlying conditions that will influence the perioperative course, particularly the postoperative recovery, referral for additional preoperative management (prehabilitation) can be helpful in optimizing their clinical status prior to proceeding with a major surgical procedure.²⁴⁻²⁶ For most patients, the specific management strategies required to optimize the patient for anesthesia and surgery are often best defined when input is provided by the anesthesiologist who is most knowledgeable about the impact of chronic conditions on perioperative care needs as well as the implications of anesthesia on underlying physiology.

INTRAOPERATIVE (INTRAPROCEDURAL) MANAGEMENT

A number of initiatives have been implemented in hospitals throughout the world to improve intraoperative management, minimize complications, and reduce costs. The implementation of checklists has been demonstrated to improve patient safety in the operating room (also see **Chapter 5**).²⁷⁻²⁹ Similarly, the routine briefing (i.e., time out) before beginning a surgical procedure reduces the incidence of wrong-site surgery, facilitates communication among providers, and ensures optimal patient care.³⁰ Some hospitals and surgical services also conduct debriefings at the end of each surgical procedure to define what procedure has been completed, clarify the postoperative expectations for the patient, and ensure that all supplies and materials have been appropriately retrieved from the surgical field.³¹ These initiatives have reduced complications during surgery and, in some cases reduced costs of care. For example, the British National Health Service instituted “The Productive Operating Theatre” to improve productivity and patient outcomes during surgical procedures.^{32,33} The program includes both briefings and debriefings to identify critical issues during and after a surgical procedure. This process has reduced errors and facilitated the transition from the operating room after a surgical procedure. Operating room utilization has increased, turnaround times shortened, and waste reduced. Significant financial savings have also resulted from this effort. The National Health Service is implementing similar initiatives in other hospital settings, such as “The Productive Ward” to build on the success achieved in the operating room environment.³⁴ Anesthesiologists need to be part of such initiatives that ensure there is an integrated approach to management during the intraoperative periods in order to demonstrate a significant and sustained impact on outcomes.

POSTOPERATIVE MANAGEMENT

The transition out of the operating room represents another important opportunity for anesthesiologists to enhance the quality and safety advances achieved in the operating room and improve perioperative patient outcomes. Advances in anesthesia safety have been acknowledged by the Academy of Medicine (formerly the Institute of Medicine) of the National Academy of Sciences¹ and other groups as a result of better anesthetic drugs, new anesthetic techniques, and improved monitoring. Although the incidence of intraoperative complications has been dramatically reduced, complication rates in the postoperative period remain high. The impact of variability in anesthetic practices on postoperative outcomes—beyond the immediate postoperative period—has received increasing attention for both patients who remain hospitalized and those who experience unintended and often unrecognized sequelae of anesthesia and surgery after discharge. For example, after a surgical procedure requiring tracheal intubation, a significant number of patients experience postextubation stridor or dysphagia that may last for days. These findings compromise the ability to protect the airway, particularly during sleep.³⁵ Does the dysphagia contribute to postoperative pneumonia that may not become clinically apparent until after discharge? Similarly, the most common healthcare-associated infections are pneumonia and surgical site infection, supporting the concept that intraoperative management is an important determinant of postoperative outcome.³⁶ Many other intraoperative strategies also impact long-term outcomes beyond the immediate postoperative period. Three examples support this conclusion. First is the influence of intraoperative fluid and vasopressor management on postoperative metabolic status and renal function.^{37,38} Second, intraoperative glucose control can have a major impact on wound healing.³⁹ Finally, and more recently, anesthetic management can influence postoperative cognitive dysfunction for both adults and children.^{40,41} As a result of these findings, anesthesiologists have a responsibility and an opportunity to understand the causes for these and other complications. We need to understand how anesthetic management contributes to adverse outcomes and how we can modify both intraoperative and postoperative care to reduce them.

COORDINATED PERIOPERATIVE MANAGEMENT STRATEGIES

While each of the components of perioperative care have specific requirements and approaches to optimize management, improve outcome, and potentially to reduce cost, perioperative management strategies must be assessed collectively, often using evidence-based clinical pathways to ensure that the goals of perioperative medicine are met.^{42,43} Anesthesiologists have the opportunity to address these needs. To achieve these goals, however, anesthesiologists must reassess current models of care and modify some practices. One critical challenge to effectively coordinate care is the complexity of the perioperative course and management. In most clinical situations, it is no longer possible, nor appropriate, for a single anesthesia provider to participate in all aspects of the perioperative course. Perioperative, intraoperative, and postoperative care are often provided

by different anesthesiologists, including pain medicine and critical care anesthesiologists in selected cases. To optimize perioperative management under this model requires improved communication and collaboration *among the anesthesia providers* as well as with others who participate in a patient's care. For some patient populations, such as geriatric patients or those with complex comorbidities, co-management agreements with other specialists can be executed to optimize care across the perioperative continuum, while clarifying roles and responsibilities.⁴⁴ The electronic health record is a valuable source of clinical information, but cannot substitute for more direct communication among providers, particularly in the management of complex clinical problems (also see [Chapter 6](#)).

The collaborative approach to care may not seem essential for healthy patients undergoing straightforward procedures. However, the value and opportunities for anesthesiologists to take a larger role in perioperative care is clearly evident for almost all patients—and the coordinated approach is appreciated by patients who are often confused about who is managing their care.⁴⁵ For example, patients undergoing “simple” procedures often have postoperative clinical issues that are underrecognized and require assessment and management. Anesthesiologists, surgeons, and nurses provide patients with instructions and information to help them manage their postoperative course, often at a time when they are not able to understand or process the information. As a result, even in these cases, the anesthesiologist can be instrumental in addressing postoperative anesthesia-related problems and coordinating the transition of the patient's care back to the primary care provider. The surgeon can provide information about the surgical procedure by forwarding the operative note to the primary care provider, but it rarely addresses any issues related to anesthetic management, concerns about the airway or potential for airway obstruction, or sequelae related to anesthetic agents, narcotics, muscle relaxants, or regional anesthetic blocks. In many cases, a phone consultation or teleconference is sufficient to address clinical needs. In other cases, a formal postoperative office visit may be required, as some anesthesia practices offer. Expansion of the postoperative assessment and management can be very helpful to patients, the surgeons, and other providers at the facilities to purvey a level of support to the patients that is often unavailable. The adoption of information technology resources and continued evolution of medical informatics (see [Chapter 4](#)) can enhance communication between patients and physicians during the entire perioperative period.

Besides the desire for a more coordinated approach to the entire perioperative course for every patient, a more formal and robust perioperative management strategy must be available for those patients with underlying medical conditions, those undergoing complex surgical procedures, and those needing prolonged hospitalization. In addition, for patients who require skilled nursing or rehabilitation services after discharge and for those needing home health services, the transitions of care create challenges for ensuring that postoperative management strategies are maintained, responses are assessed, and therapy is modified as needed. By its very nature, perioperative care for these patients is collaborative, requiring input and expertise from a number

of different disciplines, including, but not limited to, anesthesia subspecialty expertise, surgeons, and medical subspecialists. Diverse perspectives and clinical expertise are essential, particularly for the more complex procedures in patients with multiple comorbidities. At the same time, the coordination of care must be assumed by a provider who is able to integrate the diverse perspectives into a comprehensive plan of care consistent with each patient's needs and goals. In the distant past, this coordination was provided by the patient's primary care provider, who maintained a role throughout the perioperative period. With the increasing complexity of perioperative care, changing demographics, and need to provide more efficient and coordinated care to reduce overall costs, the anesthesiologist has the opportunity to assume a more involved role in the management of some of these patients. To do so will require the commitment of the anesthesia practice to this new model of care and, in many cases, the acquisition of new clinical and management skills to deliver optimized care that is efficient and consistent with patient expectations.

One of the most prominent barriers for an anesthesia department to assume a greater role in perioperative management is its own members. It is imperative that there be consensus from all members of the department that a coordinated strategy is important and consistent with their expectations. To achieve department support, it is vital to clarify that perioperative management is a comprehensive approach to care that involves a diverse group of providers. Every member of the group must participate in the overall commitment to perioperative care. The care will be provided by a number of different anesthesiologists, each with different clinical expertise. One example of this coordinated approach to perioperative care is the management of a patient with a history of chronic severe pain who undergoes a complex surgical procedure. The patient will undergo extensive evaluation and optimization of care in the preoperative evaluation programs. Intraoperative care will be provided by another anesthesiologist, one who has communicated with the patient and understands all of the clinical issues identified and addressed preoperatively. When the patient is transferred to the ICU for postoperative care, which includes ventilator support, intensive respiratory care, hemodynamic monitoring, and fluid management, the transition from the anesthesiologist who provided intraoperative care to the critical care anesthesiologist is seamless. Pain management is provided by the pain service in collaboration with the critical care anesthesiologist (also see [Chapters 51 and 82](#)). The remainder of the patient's course of care will be managed by a member of the anesthesia department to facilitate transition to another care facility or home, and to ensure effective communication with the primary care provider or other caregivers. Although this model is foreign to many practices, it represents one of many approaches to optimizing perioperative management and takes advantage of the expertise of anesthesiologists in the overall care of the patients they anesthetize.

Finally, new approaches to perioperative management also require that each practice acquire the necessary operational, clinical, and financial data, as well as the analytical capability to interpret it. Larger regional and national organizations have the broad expertise available to analyze the practice and determine where improvements in processes

can benefit patients and enhance the efficiency of the practice. For smaller practices, it can be challenging to have this broad level of expertise and access to information, although some have very successfully incorporated these strategies. As a consequence, in the United States there has been considerable consolidation of anesthesia practices by large regional and national organizations.⁴⁶ This consolidation has enabled the larger, often multi-institutional group to provide the resources needed to help anesthesia practices optimize perioperative management and document the value of the anesthesia services from both a clinical and financial perspective. Some groups have transitioned to multispecialty groups or recruited hospitalists or other providers to the anesthesia practice to supplement the clinical skills of the anesthesiologists so that the department has the diverse clinical and management expertise needed to optimize perioperative care. This multidisciplinary approach to perioperative care enables the group to expand its scope of practice and to develop clinical and administrative databases that allow them to document the value of their services to both patients and the institution. From an administrative perspective, this strategy better positions the practice to negotiate with representatives from the hospital or health system, particularly when advocating for the share of bundled payments. Because the administrative and analytical capabilities are essential to optimize delivery of perioperative care, each practice of whatever size will need to identify the most effective ways to develop this expertise and acquire the data needed to successfully address the many challenges facing anesthesia practices.

Models of Perioperative Care

Most health systems and providers are challenged to identify ways to become more efficient and reduce costs while maintaining or improving the quality of care, particularly perioperative care. Accomplishing these diverse goals is difficult and no single model of care works for every patient population or healthcare setting. As a result, many approaches to delivery of perioperative care have been implemented, some of these successful and some for which the outcome remains unknown. Although models of perioperative management include the anesthesiologist, other providers have participated in the preoperative and postoperative management of complex patient populations, each with variable success. Based on these experiences, the key aspects for any model for perioperative management include: (1) an understanding of the specific patient population included in the model (e.g., specific surgical procedure), (2) sufficient clinical and financial information to allow evaluation of the management strategies and their implications, and (3) coordination and collaboration among all providers participating in the model.⁴⁷ As models for perioperative management have evolved, they have taken advantage of the experiences from the hospitalist model for inpatient care and the medical home model for chronic disease management.

PATIENT-CENTERED MEDICAL HOME

The medical home model, also referred to as the "patient-centered medical home" (PCMH) refers to the model of care

in which a primary care physician provides comprehensive care to improve health outcomes for a population of patients.⁴⁸ The critical element of the PCMH is the coordination of care to reduce emergency room visits and hospitalizations. In managing the patient population, a number of strategies are implemented to reduce costs and improve outcomes. These models often utilize additional providers, including advance practice nurses, respiratory therapists, physical therapists, and patient advocates to manage chronic diseases such as asthma, chronic obstructive pulmonary disease, heart failure, and diabetes mellitus. Payment for the PCMH includes FFS payments for episodes of care as well as payment to coordinate care. This model has been successful in improving care, particularly for patients with selected chronic diseases, although the financial success has not been consistently achieved.⁴⁹⁻⁵¹ In some cases, the PCMH actually resulted in increased hospital admissions.⁵² Despite the variable success of the PCMH, there are some lessons that can be applied to perioperative care. First, preoperative assessment must be comprehensive enough to identify underlying clinical problems and effectively manage them, both preoperatively and postoperatively (also see [Chapter 31](#)). For the anesthesiologist managing the perioperative period, chronic conditions must be addressed; the management of these cannot be deferred to other providers. The implications of the perioperative needs must be taken into account when managing chronic diseases during the course of surgical care. Second, the underlying medical conditions must be considered as part of the proposed procedure and its implications for postoperative management. This broader perspective requires coordination with the surgeon and for some patients, the hospitalist, other specialists, and the primary care provider. For example, a patient with peripheral neuropathy associated with diabetes mellitus may be unable to participate in traditional approaches to rehabilitation; care must be tailored to the specific needs of each patient in consultation with others who can modify care as needed to optimize likelihood of achieving the desired outcome. Third, while participation by anesthesiologists is essential, many aspects of perioperative care can be managed by other providers, including other physicians and advance practice nurses. The keys to successful perioperative management, however, require that there be a single physician responsible for coordinating care among the team of providers, ensuring consistent and ongoing communication about patient care needs, and the availability of data that can be used to analyze clinical and business practices, costs of care, and outcome measures. The responsible provider during the perioperative period may be the anesthesiologist, surgeon, or hospitalist. As the patient recovers, the responsible provider may transition to the primary care provider, as long as there is good communication and appropriate “hand-off.”

SURGICAL HOSPITALIST

Another model that has been implemented in many hospitals in the United States and other parts of the world is the surgical hospitalist model, which builds on the hospitalist model of care for inpatient medical patients. Many studies have documented the clinical values and other advantages associated with implementation of a robust hospitalist

program.^{53,54} Most of the programs have been focused on the care of patients with acute (and perhaps underlying chronic) medical problems rather than patients undergoing surgical procedures. For the surgical patient, the role of the surgeon is evolving for a number of reasons: the percentage of surgical inpatients is increasing, and inpatient clinical needs are becoming more complex and difficult for the surgeon to manage without additional support. As a result, many hospitals are recruiting hospitalists to provide perioperative care for surgical patients.^{53,54} In some cases hospitalists work with specific surgical services (or an individual surgeon) to manage overall care and transitions of care into and out of the hospital environment. The models for surgical hospitalist programs vary, in some cases incorporating hospitalists with primary training in internal medicine or pediatrics, and in some cases, having a surgeon with interest in perioperative care take on the hospitalist role. In each model, the clinical management issues are similar, though the knowledge and skill to manage patients with complex comorbidities may differ considerably.

Many of these surgical hospitalist models have been successful in optimizing care of both underlying medical conditions and perioperative needs related to the surgical procedure. Although there is limited experience to document the effect on hospital lengths of stay and readmission rates, the models have been effective at improving timeliness of interventions, and patient and staff satisfaction.⁵⁴ For this model to be most effective requires that the surgical hospitalist be knowledgeable about the idiosyncrasies of perioperative management related to the specific surgical procedures. Their effectiveness is most evident when the care of underlying medical conditions is carefully coordinated with the other perioperative needs of the patient. For example, the neurosurgical hospitalist must understand concepts such as cerebral autoregulation and the impact of clinical interventions on cerebral hemodynamics for the patient who has undergone a neurovascular procedure. Similar considerations must be addressed for hospitalists working collaboratively with other surgical services.

The surgical hospitalist model has been very effective in allowing surgeons to concentrate their efforts in the operating room. However, the optimal relationship between the surgical hospitalist (whether a surgeon who has assumed this nonoperative responsibility or a medical hospitalist) and anesthesiologist during the immediate perioperative period has not been standardized. In some cases perioperative care is transferred from the anesthesiologist to the hospitalist in the immediate postoperative period; in other cases, care may be transferred from the anesthesiologist to an intensivist (either a critical care anesthesiologist or another intensive care physician) while the hospitalist maintains responsibility for managing some of the underlying clinical conditions. In the latter case, the roles and responsibilities of the anesthesiologist, critical care provider, and hospitalist need to be clearly defined to ensure appropriate coordination and transitions. Either model can be effective when coordination of responsibilities is clearly delineated. Another important component in the perioperative care of the patient is the transition from the inpatient to outpatient setting. When possible, there should be good communication and coordination of the transfer of care to the outpatient physician who is provided sufficient information about

the intraoperative course and its implications, including any issues that arise as part of the anesthetic management that might impact postoperative management.

ENHANCED RECOVERY AFTER SURGERY

Enhanced recovery after surgery (ERAS) is another example of a creative approach to the perioperative management of patients who undergo major surgical procedures.^{55,56} ERAS protocols are evidence-based pathways designed to improve care and outcomes as well as efficiency in the perioperative period. ERAS protocols require a multidisciplinary approach to perioperative care with particular emphasis on the entire perioperative course. The most successful ERAS programs are the ones that include participation by all of the healthcare and service providers who have a role in the perioperative course for the patient population.^{57,58} Most ERAS protocols include preoperative education, perioperative antimicrobial management, pain management strategies, and early rehabilitation. In some cases, separate protocols have been initiated to address each period in the perioperative course, one to address the immediate perioperative management strategies and another to concentrate on the patient-care needs outside of the immediate postoperative period.⁵⁹ Many successful ERAS protocols have been implemented to optimize care of patients undergoing a variety of surgical procedures, including laparoscopic and other colorectal procedures, breast surgery, and urologic surgery.^{60,61} Recently an ERAS protocol was implemented to optimize perioperative management of living liver donors⁶² and another designed to improve perioperative management of patients undergoing elective craniotomy.⁶³ Each of these protocols has resulted in improved patient outcomes. For some patients, hospital lengths of stay and postoperative complications were reduced by as much as 30% and 50%, respectively^{64,65}; for others postoperative pain management was improved despite administration of less opioids.^{60-62,66}

As noted earlier, one of the most important features of the ERAS program, as with other pathways designed to improve perioperative care, is that the protocols are developed by a multidisciplinary group of providers that includes physicians, nurses, respiratory therapists, and others to ensure seamless coordination across the continuum from preoperative, intraoperative, and postoperative (postdischarge) periods.⁶⁷ The anesthesiologists offer essential information about key components of anesthetic management that can be modified to improve outcomes.

The outcomes associated with implementation of ERAS protocols have generally been positive for patients, providers, and health systems. In addition, the implementation of the protocols with participation of all providers involved in patient care enables a comprehensive review of the clinical course and outcomes, costs, and resource needs. The participants should be encouraged to review the clinical, financial, and other data regularly and, if appropriate, to modify the protocol to optimize care. One protocol recently implemented to improve care in colorectal surgery identified an increased incidence of acute renal injury.⁶⁸ The patients at risk for acute renal injury were those who had longer operative times and an associated diagnosis of diverticulitis. The findings emphasized a need to reassess the management

strategies and to implement a goal-directed approach to fluid management intraoperatively and postoperatively. Follow-up will be required to determine if these changes in the protocol will be successful. These findings, however, emphasize the need to not only work collaboratively during the development of the protocol, but also review the experiences after implementation and modify the protocol when adverse outcomes occur.

Based on experiences with many of the ERAS protocols initiated to date, this approach to refining and improving care has been successful in improving outcomes and lowering costs. From a healthcare economic perspective, the ERAS protocols represent a value-based approach to optimizing care.⁵⁵ The development of the protocols give anesthesiologists an opportunity to engage in discussions with surgeons and other providers involved in the patients' care about how to optimize perioperative care and how to modify anesthesia practice and pain management strategies to facilitate recovery and potentially reduce complications. At the same time, while the reported improvements in outcome are impressive, anesthesiologists and other providers should ensure that outcome measures of most importance to patients are incorporated into future ERAS protocols in order to enhance their value.^{58,69}

PERIOPERATIVE SURGICAL HOME

The expanding roles identified for anesthesiologists provide the foundation and framework upon which they can take on even broader roles as perioperative physicians.⁷⁰⁻⁷² The American Society of Anesthesiologists (ASA) in collaboration with other medical specialties has developed the perioperative surgical home (PSH) as a model for coordinating care throughout the entire perioperative period.⁷³⁻⁷⁵ Many of the concepts incorporated into the PSH are built on the same foundation as those incorporated into the PCMH model. The PCMH is designed to better manage patients with complex medical problems and comorbidities in the outpatient setting,⁴⁹⁻⁵¹ whereas the PSH emphasizes clinical management of the patient from the time of scheduling of a surgical procedure through the entire perioperative period. The PSH is designed to specifically optimize outcomes during and after surgery, and to facilitate the transition of the patient back to the primary care provider. As with PCMH, the concept of the PSH model is to provide patient-focused care, consistent with patient goals and expectations. The goal for the PSH is to develop evidence-based clinical pathways designed to improve outcomes, and reduce overall costs-of-care across the continuum, including costs associated with home care and skilled nursing facilities.⁷⁶ Although the goals for implementation of the perioperative surgical home are clear, there is no single model nor list of specific guidelines one can follow when implementing a PSH. For some PSH models, the anesthesiologist assumes primary responsibility, whereas in other cases the surgeon is the lead provider. For some PSH models, co-management agreements with other providers has facilitated coordination of care and resulted in fewer surgical cancellations, less complications, lower lengths of stay, and fewer readmissions. For many PSH experiences, even when the anesthesiologist assumes a major role in the overall care of planning and execution, input from other providers (including hospitalist or medical

subspecialist) is obtained based on the clinical needs of the patient. The collaborative relationships that are developed under the PSH extend to the care of other patients and provide the opportunity for other providers to better understand the skills, roles, and responsibilities of the anesthesiologists. These relationships are also critically important in representing the value anesthesiologists have under bundled payment models.

Although the goals for the PSH and ERAS protocols have some similarities, the components and overall goals for the PSH are somewhat broader than the expected outcomes for ERAS protocols. As proposed by the ASA, the PSH has the following major goals:

- identify the patient and proposed plans;
- facilitate communication among the surgeons, anesthesiologists, and others as needed to coordinate care;
- provide thorough preoperative assessment and develop a care plan, including management strategies for associated diseases;
- develop and implement evidence-based protocols for clinical care throughout the perioperative period;
- manage clinical care across the continuum; and
- measure and publicly report outcomes and performance.

The fundamental components of the PSH are clearly desirable goals and build on many of the basic concepts of perioperative medicine. The PSH is generally more comprehensive, requires thoughtful leadership and institutional commitment beyond what is often required for an ERAS protocol designed to reengineer care for a focused surgical procedure.^{76,77}

A number of examples of the PSH model have been successfully implemented for selected patient populations with impressive results.^{78,79} Some are relatively straightforward evidence-based strategies to optimize perioperative care, whereas others are more comprehensive. The process for developing a PSH can be cumbersome and requires a great deal of coordination across both inpatient and outpatient settings and, in some cases, participation of different healthcare systems. The model requires a designated physician leader who has responsibility for overseeing the continuum of perioperative care. To implement a successful PSH requires that the physician champion have some training and experience in process improvement strategies.⁸⁰ The model also requires support from other providers, particularly surgeons and hospital administrators.⁸¹ Although the PSHs have been implemented in a variety of healthcare settings, the most comprehensive models can be successfully implemented in “closed” healthcare systems, such as the Veterans Administration, Kaiser, and other fully integrated delivery models.^{79,82-84} The implementation is more challenging when the PSH requires participation of providers and facilities from multiple different environments, as may be required for patients needing rehabilitation, skilled nursing, or home care.

Despite these constraints, the implementation of the PSH has been successful with improved clinical care, reduced costs, shorter lengths of stay, fewer hospital readmissions, and both provider and patient satisfaction. The fundamental components of the PSH are clearly desirable goals and build on many of the basic concepts described for perioperative medicine. The model has promise in addressing

the challenges associated with care to patients with complicated medical problems who are scheduled to undergo a complex surgical procedure. How effectively this model can be expanded to address this broader patient population and engage more providers and health systems is still to be determined.^{77,85}

Conclusion

Perioperative care continues to evolve, in large part because of the advances made in surgical and anesthesia management of patients undergoing complex procedures in the operating room and nonoperating room settings. Surgical procedures are now commonly performed on patients with underlying medical conditions that impact anesthetic and surgical management. At the same time, and, in part as a result of the changing patient population, the cost of care continues to escalate. Payors are concerned about the increasing costs of care and, in some cases, point to the lack of evidence to support some costly clinical practices. Medicare and some private payors are transitioning to MIPS with associated incentives for providing value-based care and penalties for poor performance.⁸⁶ At the same time, providers are being asked to assume greater risk by providing bundled payment for selected diagnoses. To address these dramatic shifts in payment and concerns about the overall costs of surgical care, new models of perioperative care and implementation of clinical pathways based on evidence have evolved. These new models of care require better cooperation and coordination among all providers. The concepts behind perioperative medicine provide the framework upon which to reengineer care to address these challenges. Although no single strategy is appropriate for all clinical settings and patient needs, the one critical component of perioperative medicine is the need to implement a model of care that ensures coordination, collaboration, and improved transitions across the continuum from preoperative assessment and management to postoperative rehabilitation. These elements provide the opportunity for anesthesiologists and anesthesia departments to expand their scope of practice, building on the successes in improving intraoperative quality and safety. A number of alternative approaches to optimizing perioperative care may be appropriate and in all likelihood, multiple strategies will be required to address the idiosyncrasies of each patient population, surgical procedure, and institutional capabilities. The PSH is an example of a new creative model that might have significant benefit for selected patient populations; aligning patient’s, provider’s, hospital’s, and payor’s goals; and significantly improving perioperative care by building on the experience and successes of other approaches including ERAS, the surgical hospitalist model, and the PSH. To successfully assume an expanded role, anesthesiologists will have to build on their clinical expertise, and will have to acquire and analyze data on outcomes and costs to document that the new models of perioperative care are fulfilling the needs of all providers, health systems, payors, and, most importantly, patients.

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