Review Article

The Evolution and Practice of Acute Pain Medicine

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Abstract

Background. In recent years, the field of acute pain medicine (APM) has witnessed a surge in its development, and pain has begun to be recognized not merely as a symptom, but as an actual disease process. This development warrants increased education of residents both in the performance of regional anesthesia as well as in the disease course of acute pain and the biopsychosocial mechanisms that define interindividual variability.

Review Summary. We reviewed the organization and function of the modern APM program. Following a discussion of the nomenclature of acute pain-related practices, we discuss the historical evolution and modern role of APM teams, including the use of traditional, as well as complementary and alternative, therapies for treating acute pain. Staffing and equipment requirements are also evaluated, in addition to the training requirements for achieving expertise in APM. Lastly, we briefly explore future considerations related to the essential role and development of APM.

Conclusion. The scope and practice of APM must be expanded to include pre-pain/pre-intervention risk stratification and extended through the phase of subacute pain.

Key Words. Acute Pain Medicine; Anesthesiology; Regional Anesthesia; Organization

Introduction—Nomenclature of the Field

The concept of a formal acute pain service (APS) was first suggested by Ready in 1988 as an anesthesiology-based postoperative pain management service [1], although an anonymous editorial advocating the creation of analgesia-providing teams had been published by Anaesthesia and Intensive Care in 1976 [2]. In 1988, guidelines for the management of postoperative pain were introduced in Australia, with subsequent guidelines introduced in the United Kingdom in 1990 and in the United States in 1992. Practice guidelines for the treatment of acute pain were first offered by the American Society of Anesthesiologists Task Force in 1995, with revisions following in 2004 [3]. Similarly, in 1995, the Quality of Care Committee of the American Pain Society published a consensus statement for the treatment of acute and cancer pain [4]. Succeeding in their efforts, the Joint Commission on Accreditation of Healthcare Organizations established standards in 2001 for the pain management of hospitalized patients [5,6]. Each of these entities recognized that the effective treatment of acute pain would require improvements not just in clinician performance, but also in the systems-level organization of acute pain therapies.

These initial interests in the structured management of acute pain have given way to scientific approaches to acute pain medicine (APM). Commensurate with the “Decade of Pain,” coined by Congress, the field of pain management has not only rapidly grown in number of providers, but has expanded in scope and capability (National Pain Care Policy Act). Considering the possible redefinition of Anesthesiology to carry the title, “perioperative medicine,” the semantics of “pain medicine” warrants due attention.

APSSs are rapidly evolving services led by anesthesiologists, which seek to manage pain in the preoperative, intraoperative, and postoperative phases. APSs are further tasked with consults stemming from nonsurgical pain, such as that related to acute cancer or trauma. In some hospitals, however, independent chronic pain clinics/services are consulted on nonsurgical patients who present with a lengthy history of preexisting pain. This...
difference may be attributable to different expectations for inpatient pain coverage responsiveness and availability. Regardless, the optimal practice of APM requires unique diagnostic, medicinal, and interventional skills, along with different organizational methods that exist within the common practices of chronic pain medicine. For instance, APM teams must design systems to provide comprehensive, around-the-clock acute pain care, managing requests for assistance beyond those typically treated in chronic pain medicine.

At the very least, we can begin to focus on the current inadequacy of the term regional anesthesia (RA). While some diversity exists, following a fellowship in APM, a physician is far beyond simply placing needle tips in the appropriate perineural space; in general, APM enhances in-depth decision making regarding the appropriateness of RA and other acute pain modalities in the perioperative realm. This is only a small portion of the clinical decision making that occurs, however. Postoperatively, an APM service follows patients daily, managing their indwelling catheters (whether in their homes or at the hospital) and determining appropriate analgesic modalities (such as nonnarcotic adjuncts), in order to optimize pain relief. An APM physician must approach the patient comprehensively and in a multidisciplinary context, focusing on aspects of care that impact pain management beyond isolated interventional or pharmacological approaches. For those patients who are not candidates for interventional modalities, the physician’s aim is to optimize other therapies (i.e., physical therapy, pharmacological and nonpharmacological modalities, etc.), focusing on pain management instead of the loftier goal of “total pain relief.”

RA—by virtue of its specificity for peripheral, paravertebral, and neuraxial nerve blocks—represents a collection of techniques similar to central venous catheter placement or echocardiography. Anesthesiologists who complete a cardiothoracic anesthesia fellowship do not refer to themselves as “transesophageal echocardiography anesthesiologists,” however. While RA encompasses a variety of important skills, noninterventional decision making serves as the cornerstone of management. The APM specialist chooses the appropriate analgesic modalities for specific comorbidities or surgeries, postoperatively stratifies patients in monitoring for specialized pharmacotherapy (e.g., ketamine and dexmedetomidine infusions), and modifies therapies according to regular pain assessments. This difference is perhaps best illustrated in caring for a patient who is not a candidate for a nerve block yet is expected to suffer from severe postoperative pain. In this situation, the APM physician continues to see this patient preoperatively, intraoperatively, and postoperatively throughout his hospitalization, exceeding the usual patient–physician relationship for anesthesiologists. This specialized form of pain medicine, being shaped by APM physicians, evaluates and treats surgical and nonsurgical acute pain in a comprehensive and dynamic way.

Numerous names have been proposed to describe the management of acute pain, such as “acute pain medicine,” “regional anesthesia and acute pain medicine,” and “Perioperative pain medicine and regional anesthesia.” Of these, “acute pain medicine” is the most succinct and all-encompassing term, figuring acute pain both in the surgical and nonsurgical sense, as well as in interventional and noninterventional modalities. Each of these titles, however, may specifically describe the role of a given service that treats hospitalized patients suffering from pain. This article will explore the progression of these types of services in terms of their respective complexities and abilities. While a debate on terminology will likely continue, we suggest that the term “acute pain medicine” is the most comprehensive and descriptive.

**Evolution of APM’s Role: An Anesthesia Perspective**

While cultural, organizational, financial, and governmental factors contribute to a wide diversity among APM organizations, we have noted a general, within-system evolution of APM systems (Figure 1) [7,8]. Through our direct experiences and by evaluating relevant literature, we have found that many APM programs evolved from

**Figure 1** Overview of the progression of regional anesthetic applications into formal acute pain medicine programs. RN = registered nurse; PT = physical therapy; CNB = central neuraxial block.
anesthesiologists interested in using nerve blocks as part of their intraoperative anesthetics. From a systems perspective, this user-dependent implementation represents a “stochastic” RA program—wherein nerve blocks and multimodal analgesics (MMA) are used in a pseudorandom pattern, either out of necessity or by enthusiastic parties. These systems may then evolve into “deterministic” RA programs, in which blocks and MMA become the system’s “norm.” At this stage, it is the absence, rather than the presence, of a block or MMA that becomes notable. Informal yet deterministic RA programs tend to develop into formalized organizations containing protocol-based RA programs. Such protocol-based systems permit even anesthesiologists and surgeons who are foreign to a specific perioperative system to participate in the RA program. The combination of a protocol-based RA program and a method to follow up with RA patients facilitates the use of continuous nerve blocks, a procedure that requires training health care professionals (such as nurses, and occupational and physical therapists) to optimize the care of the patient outside of the operating room (OR) with an indwelling continuous nerve block. Such systems-level arrangements may also have important implications regarding cost containment, patient throughput, and variance reduction—each of which is critical to improving the quality of APM practice. The modern perioperative pain medicine (PPM) service is born of this organizational construct. With this level of organization in place, the PPM service begins stratifying patients into low-variability, high-throughput, protocol-based systems, as opposed to high-variability, low-occurrence cases requiring more intensive, specialty resource allocation.

The PPM service evolves into a broader hospital-based pain program, as an APM service, when it begins assisting in the care of patients suffering from acute pain, outside of the perioperative environment. The earlier stratification efforts described for surgical cases thereafter expand into a multidisciplinary consulting service. With this evolution, the APM team undertakes cases alongside experts in addiction medicine, palliative care, psychiatry, rehabilitative medicine, and chronic pain, further enabling the health care system to offer expert, and seamless, acute pain therapy across a broad variety of etiologies. One of the cornerstones of the APM services has been the evolution of specialized acute pain nurses. Many hospitals have used nurse-initiated APSs with excellent results when anesthesiologist-based APSs were not available [9,10]. APS nurses fulfill a critical role in standardizing pain assessment and treatment protocols, as well as in educating patients and serving as bedside nurses in acute pain management programs. Much of the early, therapy-based success by APS nurses resulted from the implementation of basic epidural and patient-controlled analgesic (PCA) management services [11]. The evolution of these services eventually led to collaboration with anesthesiologists (with expertise in RA), surgeons, psychiatrists, and other specialists, facilitating a more comprehensive approach to treating patients suffering from acute pain. The progression from an APS to an APM team is realized by an APM team’s ability to extend the administrative and educational roles of the acute pain nurse, thus raising the level of individualized care for patients through consultation with the acute pain physician. The physician is then able to deviate from a singular focus on protocol-driven care and direct the evolving daily diagnosis and treatment of patients affected by acute pain through employing a broad array of medical and interventional approaches, and involving other medical, psychiatric, and surgical disciplines, as necessary [11–14].

What Should the Role of the APM Service Be?

The primary objective of the APM service is to diagnose and treat acute pain as a pathophysiologic ailment. The role of the APM team is not to simply treat pain as a symptom, as this may mask the underlying pain disease process that must be managed in order to prevent further suffering and morbidity [15,16]. Rather, the APM team must focus on managing pain under the auspices of developing a differential diagnosis, either finalized or under evaluation. Therapies should have their kinetic profile modeled on the expected natural history of the underlying nociceptive load. This requires that APM teams work in close collaboration with primary patient care teams in order to fully optimize patient comfort. Regardless of what therapies are selected, the risk–benefit ratio must be optimized for each individual patient, therefore necessitating personalized patient–physician contact.

While acute pain can exist as an isolated entity within the spectrum of pain disorders, many patients will suffer from additional issues such as acute-on-chronic exacerbations of pain [17–19], associated diagnoses of addiction [20–22], or even breakthrough pain under the auspices of palliative care [23,24]. This spectrum can be expanded further by incorporating biopsychosocial pain modifiers [25–31]. Each point on the pain continuum requires differing levels of expertise in pain management, owed to the increasing levels of complexity of pain etiologies. For instance, the potentially malingering patient, who has a history of a major depressive disorder, chronic pain treated with methadone, and substance abuse, and who—two weeks following an open repair of a tibial plateau fracture—suddenly complains of acute pain, cannot be optimally managed by simply blocking a nerve or issuing prescription for opioids. The multidisciplinary nature of an APM team facilitates more comprehensive coordination of care not only with the primary patient care team, but also with relevant specialists [32]. This approach embraces the concept that no single type of provider can offer solutions for all elements of acute pain [33,34]. The APM physician, however, is best suited to manage and coordinate the patient’s progression through this system.

In 2002, Rawal crystallized many of the requirements for a modern APM service in an editorial on the state of APS [35]. The impetus for this editorial was a series of surveys on APS implementation rates and their effectiveness in North America, the United Kingdom, and continental
Evolution of Acute Pain Medicine

Europe, which suggested that the definition of an APS varied considerably, as did the utility of their services [36–44]. Six tenets of an APS service were thus offered:

1. Designated specialists available around-the-clock for consultation or intercession in cases of severe acute pain.
2. Regular pain assessment, appropriate for age and comorbidity, with separate measurements for pain with rest and with movement.
3. Collaboration with surgeons and “ward nurses” to develop pathways to achieve predetermined goals for “mobilization and rehabilitation.”
4. Continuing education of ward nurses on safe and cost-effective analgesia.
5. Patient education on pain monitoring, treatment options, benefits, adverse events, and analgesic goals.
6. Regular auditing of APS performance regarding cost-effectiveness and patient satisfaction with analgesic techniques.

These tenets remain core goals of modern APM service.

Henry Kehlet’s concept of “enhanced recovery after surgery” coined in the 1990s lends further validation to the necessity of an APM service [45]. Within this framework, Kehlet and Wilmore suggest adopting a hospital system-based approach to “multimodal surgery,” in which preoperative, intraoperative, postoperative, and home interventions would minimize surgical stress responses and shorten recovery and rehabilitation times [46]. The focus of such “fast track” surgical concepts is the optimization of the three variables that most often delay rehabilitation: 1) persistent need for intravenous analgesics; 2) persistent gut dysfunction due to physiologic milieu or drug side effects; and 3) immobility resultant from pain [47]. An organized APM service, integrated into a multi-disciplinary surgical model, would certainly improve these three factors and also contribute greatly to the success of a “fast-track” surgery program [46,48].

Numerous surgical-based tenants of Kehlet’s “multimodal surgery” have shown to benefit earlier rehabilitation such as avoidance of nasogastric tubes, early discontinuation of drains, minimizing excess perioperative fluid, and optimizing preoperative and early postoperative nutrition [46]. However, tasks specific to an organized APM team have also shown significant benefit in all time periods. Preoperatively, patient education to include information of pain expectation and expected modalities of pain control resulted in improved pain scores and anxiety [49–51]. In the intraoperative/perioperative realm, liaison with an organized APM service is a prerequisite to ensure an optimal intraoperative-analgesic regimen that minimizes opioid usage extending into the immediate postoperative setting. In addition to neuraxial/regional techniques, numerous opioid-sparing agents such as alpha-2 agonists, N-methyl-D-aspartate antagonists, nonsteroidal anti-inflammatory drugs, acetaminophen, and gabapentanoids have also been shown to be efficacious in decreasing intraoperative opioid requirements [52]. Such techniques managed by an APM team into the postoperative period can minimize the need for intravenous opioids, possibly decrease postoperative nausea/vomiting, hasten return of bowel function, and improve mobility by significantly decreasing dynamic pain [52–56]. However, the role of an APS may continue even into the “home” phase of rehabilitation via pharmacological recommendations and ambulatory perineural catheters systems whose use has been well established.

To accomplish these goals set forth by Kehlet and Rawal, the modern APM team must assume a number of roles within the modern health care system (Table 1). Primarily, the APM physician serves not just as a one-time consultant, but provides ongoing management, assessment, and treatment of pain as part of the underlying disease process. The APM team is also well positioned to provide administrative assistance through leadership activities and quality-improvement efforts. Modern APM teams must develop a variety of educational activities to enlist the entire health care team in the effective care of the patient suffering from acute pain. These educational efforts should expand well beyond ward patients and their nurses to include pharmacists, physical and occupational therapists, supply technicians, clerks, physicians, surgeons, and even other anesthesiologists who are not APM specialists. Administrative, educational, and research efforts may lead to findings that should be reported to the general community as either hypothesis-generating or hypothesis-testing exercises.

The importance of a systems-based approach to APM cannot be understated as the current management of pain warrants major improvements in patient care. Notwithstanding the development of chronic pain, acute issues inherent to the inadequate management of pain exist. We know opioid analgesics as the current primary management of pain, existing as such since the early 1900s, is ineffective. Consequently, as many as 0.7% of surgical patients requiring postoperative opioids will suffer from respiratory depression requiring naloxone administration [57,58]. For those patients receiving opioids via patient-controlled analgesia devices, the mean reported incidence of nausea is 32% (95% confidence interval [CI], 27–38%) and of pruritis is 14% (95% CI, 11–18%) [59]. These statistics are notable considering the existence of systems-level measures that may significantly reduce the occurrence of such events. For instance, work by Taenzer et al. has demonstrated the utility of continuous pulse-oximetry as a systems-level safety practice to decrease rescue events and intensive care unit (ICU) transfers, while a prospective randomized double-blind controlled trial by Cepeda et al. highlights the reduced incidence of pruritis and nausea with intravenous (IV) PCA use when supplemented with an ultralow dose of naloxone [60,61]. Perhaps most concerning are early reports suggesting minimal to zero improvement in postoperative pain control by PCA therapy when compared with nurse-administered opioid analgesia [62,63]. Altogether, these examples highlight the importance of hospital-wide systemic and comprehensive improvement efforts, rather than just isolated
procedures such as nerve blocks or PCA implementation, to improve management of acute pain.

Similar to Rawal’s concept that an APM service must provide an auditing system to track efficacy and outcomes, numerous tracking systems have emerged. However, such systems are largely adverse event databases and registries such as the Australia and New Zealand Registry of Regional Anesthesia or the Regional Anesthesia Surveillance System (University of Iowa) that focus only on RA techniques [64,65]. While such efforts deserve applause, they fall short in regard to capturing what is required of a modern APM service. Other large-scale efforts are in place such as the American Society of Regional Anesthesia AcutePOP, which is a large database initially geared toward quality improvement, billing, and creating progress notes [66,67]. However, being that APSs are very much locally specified entities, this effort has become more so a source for tracking RA efficacy, pharmacological demographics, and complications. What these initiatives lack is the ability to prospectively gather real-time data in a system that mirrors a multidisciplinary model of care starting preoperatively and extending to the home environment.

Goldstein et al. provided a model for such data collection utilizing a mobile electronic platform integrated into a local electronic medical record [68]. In an observation proof of concept study, Goldstein et al. captured real-time preadmission through discharge data on APM service patients while conducting daily care. Pain assessments, side effects, and even flagged records denoting inadequate therapy guided daily care and provided up-to-date quality improvement data. Instead of collecting ad hoc data, Goldstein et al. collected data in a mirror image of how they practiced APM. Of note, their group noted that despite their standard procedure, total knee arthroplasty patients reported unacceptable pain scores during physical therapy sessions [68]. While cost benefit or clinical efficiency is still to be shown, this model embraces the role of an APS on a local level, but also allows for large-scale data collection that can contribute to a larger pool and

Table 1  Service roles of the modern acute pain medicine program

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Role</th>
<th>Examples</th>
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<tbody>
<tr>
<td>Administration</td>
<td>Leadership</td>
<td>Hospital Pain Committee, Budgetary considerations, Staffing and scheduling, Intrahospital liaisons</td>
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<td></td>
<td>Quality improvement</td>
<td>Benchmarking, Patient flow, Resource utilization, Patient safety</td>
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<tr>
<td>Education</td>
<td>Protocol implementation</td>
<td>Physician protocols, Nursing protocols</td>
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<td></td>
<td>Equipment training</td>
<td>Pump in-service, Catheter care in-service, Catheter removal in-service</td>
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<td></td>
<td>Provider teaching</td>
<td>Pharmacology updates, Procedure updates</td>
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<tr>
<td>Research</td>
<td>Clinical projects</td>
<td>Drug A vs Drug B in decreasing postoperative pain</td>
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<td></td>
<td>Process engineering</td>
<td>Does a redesign of a protocol improve patient flow?</td>
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<td>In vitro studies</td>
<td>How does multimodal analgesia affect cytokine profiles?</td>
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<td></td>
<td>Outcome studies</td>
<td>Long-term survival following cancer surgery with use of regional anesthetics</td>
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<tr>
<td>Patient care</td>
<td>Interventions for acute pain</td>
<td>Neuraxial catheter, Paraneuraxial catheter, Perineural catheter, Single injection</td>
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<td></td>
<td>Follow-up and management of acute pain interventions</td>
<td>Daily rounding, Early PACU intervention</td>
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<td></td>
<td>Pharmacological therapies</td>
<td>High-variance opioid therapies, Multimodal analgesia, Ketamine infusions</td>
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<td></td>
<td>Consultant activities</td>
<td>Acute pain consults, Palliative pain, Collaboration with addiction and chronic pain medicine</td>
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PACU = postanesthesia care unit.
also guide clinical research. Thus, established APM services must not only focus on adverse event/RA technique tracking, but embrace a real-time collection of clinical data to guide care throughout the preadmission to home care periods.

Role of APM in Palliative Care

The predominance of palliative care involves patients in the final stages of a malignant illness. Patients in the latter stages of malignant diseases report up to a 75% incidence of severe pain [69]. The etiology of this pain can stem from the primary cancer itself or metastatic progression of the disease, and can manifest as various types of pain (neuropathic, bony, visceral, inflammatory, etc.). While the majority of cancer patients are well managed with pharmacological therapy, acute pain in a hospital-based palliative care setting is a frequent occurrence. This type of pain occurs in various stages of disease, including that from surgical interventions, cancer treatment-related pain, pain from metastatic disease, and pain at the end of life [70].

Although palliative care physicians are well versed in the pharmacological approaches to cancer pain, APM services can augment their capability by further embracing a multidisciplinary approach. Such an approach has already been noted to increase APS activity and offer additional analgesic modalities (interventional procedures) to certain patients who may benefit [70]. APM services offer a 24-hour, in-house capability that can augment pain assessments, pharmacological management (opioid switching, ketamine infusions, and adjunct usage), complementary therapies (acupuncture, TENS, etc.), as well as perform peripheral nerve blockade or catheterization and attend scheduled multidisciplinary patient rounds. While no prospective trial regarding peripheral nerve blocks or catheters in this population has been conducted, numerous case series have shown specific patients’ quality of life to be improved and opioid escalation avoided [71–73]. In the setting of diminished immune capability and possible coagulation abnormalities in such patients, an APM service offers the essential risk/benefit consultation needed prior to interventional techniques. For longer lasting plexus blockade or intrathecal interventions, APM services can serve as a liaison with chronic pain specialists who can perform these procedures within a reasonable amount of time.

Whether interventional or pharmacological consultation is sought, an APM service led by an anesthesiologist provides an essential multimodal tool focused on improving pain therapy and decreasing the dependence on opioids as the “sole analgesics.” While prospective in vivo human trials are underway, numerous animal models and retrospective reviews suggest that a minimization of opioids may play a role in cancer survival [74]. Investigations suggest that opioids, via their immunosuppressive, proangiogenic effects, and allowance of tumor growth, may play a key role in malignant progression [74–76]. Various models have even shown that the peripheral antagonist, methylnaltrexone, can halt in vitro tumor progression [77,78]. In regard to human studies, epidemiologic data suggest that even certain mu-opioid receptor alleles (A118G) that result in reduced opioid responsiveness are associated with prolonged survival in breast cancer patients [79]. Thus, while current data fall under the category of “suggestive,” more broad utilization of APM specialists may extend this knowledge to serve a more essential role in the realm of patient care, as their periparative interventional capabilities and postoperative multimodal philosophy may directly impact outcome in various malignancies.

Pain management in palliative care is an established practice. However, APM specialists can serve in a “hospitalist” role to augment a palliative care physician’s capability. Instead of serving as a “last resort” option, APM specialists can serve as first-line consultants in a hospital setting to enhance pain management throughout the various stages of a malignant disease [70].

Overview of Cost-Effectiveness Issues Regarding APM

Given the growing concern in the United States over health care expenditures, hospitals cannot turn a blind eye toward the cost-effectiveness of APM teams. A recent review by Sun et al. highlights many of the challenges and opportunities present in evaluating the cost-effectiveness of APS [80]. Chief among these challenges was the difficulty in defining an APS. Surveys performed in Germany, Italy, Ireland, and the United States suggest significant variability with regards to assigning specific physicians and/or nurses to the APS, standard protocols or practice parameters, quality control efforts, and widespread systematic use of multimodal and interventional approaches to acute pain management [80–84]. Furthermore, current tools for evaluating the cost-effectiveness fall on several fronts: lack of sensitivity to pain outcomes, questions pertaining to short-term and long-term outcomes, difficulty quantifying functional outcomes, the use of average effects vs individual effects on patients, and “dependence in responses across alternatives to pain management” [80].

A review by Lee in 2007 similarly identified a lack of consensus regarding standards for staffing, support, or objective outcome measurements for evaluating APS performance [85]. Nevertheless, this meta-analysis suggested that an APS intervention would be justified if the cost, per patient per day in 2005 US dollars, was less than $20. Cost savings were based on shorter ICU length of stay, shorter hospital length of stay, decreased nursing time in hospital wards, and a patient’s willingness to pay for PCA at a cost of $10 per day for hospitalization. Others have estimated the programmatic cost of anesthesiologist-based APS programs between $78 and $118 per patient per day for a three-day hospitalization, and between $32 and $100 per patient per day for anesthesiologist-based, nursing-supported APS programs [85,86]. In comparison, the daily cost of IV PCA
In numerous other reviews, preoperative traditional acupuncture and electroacupuncture in the setting up to 72 hours postoperatively [95]. Traditional acupuncture and electroacupuncture in the usage, opioid side effects, and pain scores when utilizing analysis demonstrated a significant decrement in opioid pressure, magnets, and even lasers. A recent meta-analysis has adopted different styles corresponding to different regions, as well as varying delivery methods, such as pressure, magnets, and even lasers. A recent meta-analysis demonstrated a significant decrement in opioid usage, opioid side effects, and pain scores when utilizing traditional acupuncture and electroacupuncture in the postoperative setting up to 72 hours postoperatively [95]. In numerous other reviews, preoperative traditional acupuncture resulted in similar analgesic benefits compared with sham interventions, while other studies utilizing electroacupuncture were beneficial only when used postoperatively [96–98].

Transcutaneous electrical nerve stimulation (TENS) operates under the concept of “counterirritation” by delivering varying frequencies of electrical stimulation via skin electrodes [95,99]. Theoretical mechanisms postulate the role of endorphins, serotonin, and frequency-specific opiate receptor interactions [99]. Numerous trials have demonstrated an opioid-sparing effect of TENS, particularly following abdominal and thoracic procedures [100–102]. Bennett et al. conducted a methodological meta-analysis that not only revealed a significant bias risk in the form of inadequate blinding, but also inconsistent and possible inadequate usage of TENS units in various trials (i.e., suboptimal settings) [103]. However, Bjordal et al. challenged this finding by proposing that how TENS is applied in regard to intensity may have clouded the previous negative reviews [104]. Regardless of the Complementary and Alternative Medicine (CAM) method in question, the APM consultant should provide the expertise and context awareness to appropriately identify patients who may or may not benefit from such techniques.

Role of Complementary/Alternative Medicine in Acute Pain Management

The reliance on pharmacological modalities has led to the unfortunate commitment to opioids in many acute pain settings. While the goal of multimodal therapy is to minimize the use of opioids and maximize analgesia, misuse of opioids following episodes of acute pain still remains a potent problem. In a recent report from the Centers for Disease Control and Prevention, 20,044 prescription drug overdose deaths occurred in 2008, of which 74% were due to opioid pain relievers. While the indications for these prescriptions were unclear (chronic nonsurgical pain vs. surgically related pain), the need to de-emphasize opioids is exemplified by strong evidence that poorly treated acute pain is a risk factor for chronic pain [90,92]. Additionally, the long-standing emphasis on opioid use as the primary analgesic for acute pain has generated acute tolerance and opioid-induced hyperalgesia [93,94].

Given these pharmacological challenges, nonpharmacological techniques have been the focus of intense investigation in recent years. By carrying the modifier “complementary/alternative,” the increased usage and supportive evidence for these modalities (acupuncture, massage, guided imagery, etc.) have negated the use of terminology that implies an “outsider” view of such techniques. Instead, these nonpharmacological techniques have been embraced by many institutions as part of the standard analgesic clinical pathways.

Acupuncture, one of the oldest medical modalities, has adopted different styles corresponding to different regions, as well as varying delivery methods, such as pressure, magnets, and even lasers. A recent meta-analysis demonstrated a significant decrement in opioid usage, opioid side effects, and pain scores when utilizing traditional acupuncture and electroacupuncture in the postoperative setting up to 72 hours postoperatively [95].

Effective APM Service

Environmental and Staffing Requirements for an Effective APM Service

Environmental requirements for a functional APM service can be segmented into three categories: administrative duties, rounding and consulting, and nerve block placement. Rounding, administrative, and consulting environments are typically shared with other services, as is customary for any major medical or surgical service that cares for hospitalized patients.

Environment for Administrative Duties

Each of the previously discussed roles for the APM team inevitably accrues administrative duties. The APM team requires some type of administrative workspace in which to carry out duties ranging from paperwork, meetings, conferences, and storage or records and supplies. While this would preferentially entail a secured office adjacent to the theater of either a block room or the ORs, clinical space requirements may obviate this preference. A designated space should include secured access, computer equipment, desks, a method for storing both paper and electronic files, and space for hosting interdisciplinary meetings. Given the multidisciplinary nature of hospital-wide pain improvement initiatives, and depending upon the size of the institution, meeting spaces may require room for between 5 and 50 attendees.

Environment for Rounding and Consulting

Rounding traditionally occurs at each patient’s bedside. Aside from requisite patience and kindness, the APM team must tailor its rounding environment according to the specific duties at hand. For instance, when rounding on
patients with catheter-based regional anesthetics, it may be prudent to carry supplies for dressing reinforcement and replacement. If appropriate monitoring and support is available, the rounding team may carry local anesthetics, resuscitation equipment including Intralipid (Fresenius Kabi, Uppsala, Sweden), nerve block equipment, or even an ultrasound machine with which to evaluate and manage those patients for whom the current anaglesic plan is inadequate. Most importantly, in the era of electronic medical record systems, a method with which to review information pertaining to both pain as well as general medical or surgical care is necessary to make safe, timely, and effective decisions as the patient’s hospitalization progresses.

The environmental requirements for consulting duties are generally similar to those for rounding, as listed earlier. There are occasional instances whereby care is continued on an ambulatory basis. This may consist of the management of home-going catheters for patients who receive long-term care by the APM team [56,72,105]. While the vast majority of such patients can be managed by telephone correspondence following discharge, occasionally patients wish to return for in-person follow-ups. In such cases, it is prudent to have access to a clinic-type environment whereby patients may be admitted and discharged from the hospital system within a short time frame, ranging from 30 minutes to a few hours. For the APM team, ready access to the equipment for nerve block placement and/or management within this clinic-type environment is essential to ensuring an efficient visit. Clinic-type duties are not always captured within the realm of general perioperative services, and so preplanning such visits is helpful for both the patient as well as the physician.

**Environment for Placement of Nerve Blocks**

Nerve blocks are placed in dedicated block rooms, the OR immediately before or following a surgical procedure, the postanesthesia care unit (PACU), or at the patient’s bedside. Dedicated block rooms offer perhaps the greatest convenience and potential for increasing the efficiency of nerve block placement, but incur a certain cost due to the dedicated nature of their resources. An alternative method is to create a mobile “block cart” that is moved from patient to patient. In many environments, this has become a popular option due to both increased flexibility and decreased institutional resource allocation. A nerve block cart can facilitate placement of nerve blocks in preoperative settings, the PACU, or in remote anesthetizing locations.

The block room or designated block area can also serve as an “APM lab,” akin to the “electrophysiology lab,” whereby opioid, ketamine, and other noninterventional approaches can be initiated in an accelerated fashion. Taking advantage of available support from specialized nurses, technicians, and APM physicians along with advanced monitoring capabilities, higher risk patients can be continuously observed as pharmacological interventions are advanced. This can potentially reduce risk and improve patient safety and patient satisfaction by swiftly treating acute pain exacerbations, which may be otherwise untenable on unmonitored floor beds.

For many perioperative environments, but perhaps especially for anesthesiologists in a teaching facility, a block room offers many advantages over the alternative settings for block placement. The block room permits anesthesiologists to place nerve blocks well in advance of anesthesia induction, thus removing the time pressures inherent in placing nerve blocks in the OR prior to the induction of anesthesia. These advantages are compounded when placing multiple nerve blocks in the same patient, perineural, or neuraxial catheters, or with a challenging block placement. Preoperative placement permits use of the nerve block as part of the anesthetic, and, thus, may offer a potent alternative to opioids for control of intraoperative nociception. The avoidance of time delays inherent to prolonged block placement cannot be overemphasized, as delays in the induction of anesthesia was the leading reason that orthopedic surgeons disapproved of RA for their patients [106].

While some studies suggests the block room may decrease costs and improve overall OR efficiency [107–109], this deduction is debatable [110]. Despite offering reliable evidence on the limited impact of block rooms on efficiency and cost savings, Drolet and Girard nevertheless acknowledged their significant practical benefits for the teaching and placement of nerve blocks [111]. This perception on the benefits of a block room was also shared by surgeons, according to Eappen et al., despite the evidence suggesting there were no differences in anesthesia-controlled times, turnover times, or OR end times following the implementation of a block room [112].

The block room is typically situated adjacent to the main OR and preoperative evaluation areas. To conserve resources, block room space may also be used as a PACU and/or for general preoperative evaluations, depending on the time of day, surgical volume, staffing, etc. Such cross-utilization may facilitate patient flow for the entire perioperative process and could simultaneously decrease direct costs specifically attributable to the block room. Because patients will frequently require sedation, and therefore postsedation monitoring, the number of block room slots must be greater than the number of expected simultaneous nerve block teams. The exact number of beds needed, therefore, is a product of preoperative time requirement, block procedure duration, sedation monitoring time, number of patients to be blocked simultaneously, and number of patients requiring a nerve block within a given time interval.

**APM Fellowship Training**

Currently, the Accreditation Council for Graduate Medical Education (ACGME)-certified “Pain Medicine” fellowships requires the care of a certain number of acute pain patients when a “pain hospitalist” role is fulfilled. However, in the setting of a rapidly growing perioperative and
nonperioperative acute pain presence, a small inconsistent portion of these fellowships is unlikely to provide optimal training of such physicians on the broad approach to APM. Furthermore, in the United States, many pain medicine practices primarily function in pain clinics that are separate from hospitals, which frustrate the requirement for continuous around-the-clock hospital care, as suggested by numerous national pain management organizations. It is becoming clear that a fellowship based in chronic pain is not sufficient to remain current in the rapidly expanding knowledge of acute pain treatment. Fellowships are emerging with a main focus in the treatment of acute pain. These fellowships have a wide variability: some focus entirely on the application of orthopedic procedures, while others address general surgery and trauma of acute pain in addition to orthopedic procedures. This variability is inevitable in the growth and development of a new specialty. For example, fellowships, such as those offered at the University of Florida College of Medicine (Gainesville, FL), University of Pittsburgh College of Medicine (Pittsburgh, PA), and Walter Reed National Military Medical Center (Bethesda, MD), among others, offer a year of intensive APM instruction, but also the opportunity to achieve expert competency in RA, as in any other currently offered APM program. Physicians emerging from APM training programs embrace the continuum between acute and chronic pain. They function as “pain hospitalists” and engage the chronic pain service as needed to establish outpatient follow-up or specialized procedures.

To adequately provide an APS, there must be a team of providers managed by a comprehensively trained physician acting as the cornerstone of the team. This physician formulates and disseminates the pain management plan to the team based on training, clinical experience, nursing input, patient input, and patient-specific historical management. This unique task and practice environment presents two questions pertaining to the training of an APM physician.

What Specialties Are Best Suited for the Task of APM?

The nature of acute pain necessitates that an APM physician operate in a multitude of clinical environments. In many cases, APM begins prior to the surgical insult and almost always shares elements with the patient’s anesthetic plan, especially when RA is utilized. In regard to postsurgical pain, management warrants a physician who can be involved in the acute pain continuum, starting preoperatively and extending into the recovery phase. Anesthesiology clearly serves as the specialty from which to train for an APM fellowship. During residency in anesthesiology, physicians acquire the basic procedural skills for RA and an extensive knowledge of pain and analgesia. Anesthesiologists, often defined as “perioperative specialists,” are optimally positioned to serve as liaisons with consulting medical and surgical services. However, anesthesiology residents have limited exposure to outpatient analgesic titration, complementary medicine, and the rehabilitative aspects of patient care. Similar to chronic pain fellowships that incorporate multiple specialties, APM programs would benefit from exposure to services such as physical medicine and rehabilitation (PM&R) or neurology. If nonanesthesiology specialties are accepted into APM fellowships, they would be at a disadvantage, as anesthesiology-trained, acute pain physicians have experience in supporting the intraoperative anesthesia team via techniques such as regional anesthetics, as well as interacting with surgeons in the perioperative period. If physicians with nonanesthesiology backgrounds enter into APM fellowships, it is reasonable to anticipate that they will receive sufficient training in acute pain management, but it may not be practical to expect comprehensive training in regional anesthetic techniques within the confines of a single year of fellowship.

What Should a Fellowship in APM Encompass?

Ideally, fellowship training would augment and expand a physician’s prior experience or residency training. For training purposes, APM can be broadly divided into interventional analgesic techniques (e.g., RA) and acute pain management. Whereas acute pain management is a multimodal approach, interventional techniques or RA denote an advanced analgesic modality. Many anesthesiologists are comfortable with neuraxial analgesic techniques at the conclusion of residency, but have varying levels of experience with RA despite the ACGME-required number of peripheral nerve blocks [113]. Additionally, significant experience with continuous peripheral nerve blocks varies significantly depending on the institutional culture and infrastructure in which the resident trained or practiced. Due to the depth of knowledge and extensive procedural proficiency required to perform RA, it necessitates a significant portion of training and education even when viewed as a component of the acute pain management plan.

RA and APM fellowship directors have met since 2002 to recommend the necessary components of fellowship training. The first training guidelines were published in Regional Anesthesia and Pain Medicine in 2005 and revised in 2010 [114,115]. Although RA and APM is not an ACGME-accredited fellowship, the guidelines are structured to incorporate the ACGME core competencies into the education and evaluation used in fellowship programs. The 2005 guidelines were almost exclusively designed for fellowship training in RA; by 2010, the descriptions of training in both RA and APM began to appear, which likely reflected the anesthesiology’s transition from an intraoperative focus toward a perioperative practice in general [114].

Using the 2010 guidelines for fellowship training as a robust framework for revising fellowship training in APM, several additions should be made to reflect a more holistic and multimodal goal:

Section I: Organization and Resources. While the scope of training described is adequate, more emphasis should be placed on the APM physician acting as the pain care hub, integrating multiple services (i.e., surgery, nursing, physical therapy, rehabilitative medicine, internal medicine, etc.). As
an APM physician-leader, the fellow should participate and eventually lead multidisciplinary meetings to discuss patient care and APM service issues. Fellows should also be encouraged to act as the APM service leader when interfacing with other services. The current standard and guidelines define fellowship training in RA/APM as one year, which should be adequate to effectively train anesthesiologists in both areas.

The institutional organization’s support of an APM fellowship should be similar to the guidelines; a close relationship with an ACGME-accredited residency is absolutely essential to training an APM fellow to be both a clinician and a teacher. As stated in section II later, instruction of medical students and residents in RA and APM is a requirement. A recommendation should also be made that APM fellowships have a partnership with a chronic pain fellowship. Such a relationship is mutually beneficial given that clear delineations between acute pain, acute on chronic pain, and chronic pain are not always obvious. These partnerships also afford fellows in both programs opportunities to collaborate on difficult patients with acute pain that becomes chronic, as well as on chronic pain patients who undergo surgical procedures. Program directors and teaching faculty should be similarly experienced, as described in the guidelines, although, ideally, a portion of the staff should have significant APM experience. In addition to those described in the guidelines, other resources would include a functioning APM service, as described in prior sections, with the collaboration of acute pain nursing and residents to execute the acute pain plan, while affording the APM fellow time to formulate and integrate analgesic plans. Eventually, this should result in longitudinal ownership and oversight of the service by the fellow, with individual patient analgesic plan ownership by residents.

Section II: The Educational Program. The 2010 guidelines were excellent in outlining the educational goals for fellowship. Utilizing the well-known ACGME core competencies aligns an APM fellowship with core residency and accredited fellowships. Additions should be made to more completely outline the medical knowledge required, reflecting an emphasis on multimodal treatment of various types of pain. For instance, APM fellows should gain an extensive knowledge of pain neurophysiology. A broad knowledge of neurotransmitters, nerve fiber types, and pain pathways are a solid foundation for learning the pathology of pain both centrally and peripherally. Characterizing the types of pain is essential to addressing complex pain patients beyond the routine nociceptive surgical pain. Pain syndromes should also be thoroughly reviewed, such as complex regional pain syndrome, diabetic peripheral neureopathy, and chronic back pain, as APM physician may be required to manage these patients in the hospital.

If true multimodal therapy is to be incorporated into analgesic regimens, fellows should also appreciate the contribution of biopsychosocial factors to a patient’s pain, such as depression, sleep disturbance, anxiety, and catastrophizing. As discussed before, complementary, alternative medicine techniques are increasingly used in APM. Although the modalities offered may vary by institution, a fellow should be able to make educated decisions on whether their implementation is appropriate. Time constraints make it impractical to require fellows to train in the application of modalities like acupuncture, TENS, medical massage, hypnotherapy/guided imagery, and mirror therapy. Nonetheless, these fields offer opportunities for fellows to customize their practice. Fellows should be educated on the risks, benefits, and indications of these alternative therapies, even if they are not specifically trained in them.

As the field of anesthesia evolves from intraoperative care to perioperative medicine and the treatment of pain becomes more complex, the need for a “hospitalist” acute pain physician is evident. Orienting fellows to this goal requires augmentation of the current fellowship educational guidelines to reflect the extended preoperative and postoperative missions of the APM physician. Interestingly, Neal et al. surveyed 176 former fellows from 12 programs and found that 61% are or had been academic practice [116]. Given this fact, it is also advantageous to train fellows to become both leaders and educators of medical students, residents, and nursing staff in the principles of APM.

In summary, while guidelines exist that comprehensively describe the level of expertise in patient care that a fellow should achieve through a fellowship in RA, the proficiencies in APM are still largely focused on the immediate perioperative period. RA has evolved from an intraoperative tool to a comprehensive set of options for controlling postoperative pain. Recent efforts have expanded the scope of postoperative pain control to consider its effects on functional outcomes, rehabilitation, time to discharge, and safety. APM should follow this evolution by expanding our optimization of the recovery/rehabilitative phase of care as well as the immediate perioperative period. With this goal in mind, fellows should be trained to think longitudinally. Although the bulk of clinical time will be spent in the inpatient setting, there is also a need for exposure to situations where inpatient pain management is extended to the outpatient setting. For instance, fellows should have experience managing outpatient perineural infusions; beyond this, allotting short fellowship rotations dealing with outpatient pain management, chronic pain, and PM&R would be beneficial. Being knowledgeable in the appropriate outpatient analgesic regimens and how to transition to such a regimen is a valuable asset for the APM physician when managing acute pain patients who develop chronic pain or chronic pain patients with acute pain.

Making the Team: APM Component Specialties

The modern APM team can no longer be staffed only by anesthesiologists with an interest in acute pain therapy, or by a single nurse tasked with improving hospital-wide pain control. Midlevel providers, such as advanced registered nurse (RN) practitioners, certified RN anesthetists,
Upp et al.

anesthesiologist assistants, physician assistants, RN specialists, licensed practical nurses, pharmacists, technicians, clerks, and even specialists in statistical process control, industrial engineering, and database management, play important roles in the modern APM team. Indeed, national committees from the United Kingdom, United States, Germany, Sweden, Australia, and New Zealand all recommend multidisciplinary teams staffed by, at least, nurses and physicians [41,117–120].

Physicians

APM physicians usually have a training background in anesthesiology and sometimes with a subspecialty interest and/or training in RA, orthopedic anesthesia, and/or chronic pain medicine. Attending anesthesiologist members place and follow up nerve blocks, fulfill requested consults, and lead the rounding team. Many models follow the principle that “he who does the procedure follows the patient.” In other words, we advocate that the APM team does not defer block placement to a separate team of physicians, only to be followed by the APM team. Such an arrangement, by nature, creates a discontinuity of care, leading to potential transfer-of-care errors [121–124]. Maintaining continuity may also facilitate early detection of the decompensating patient, thereby positioning the APM anesthesiologist as an early warning system for critical care intervention [125]. To this end, asking APM with a critical care “outreach” mission was shown in one hospital to decrease adverse events from 23 to 16 events per 100 patients, and cut the 30-day mortality rate from 9% to 3% in high-risk patients [126].

In this era of cost containment, some systems have relegated the anesthesiologist to a supervisory and procedural role, with many of the follow-up duties performed by nurse specialists. International surveys of APS practices indicate that routine rounding of APS teams does not occur in the majority of hospitals; those hospitals that do provide regular rounding often do so only a few times per week rather than daily [35]. Even when the anesthesiologist is relegated to a supervisory role, the final responsibility for the safe and effective relief of acute pain remains with the anesthesiologist. We suggest that an APM team should, if possible, round on patients at least twice per day in order to preempt any discomfort or safety issues inherent to continuous neural blockade, as well as increase the number of “examine-diagnose-treat-follow up” cycles available to the patient each day.

Pharmacists

As with so many health care environments, pharmacists provide an important role in the safe provision of pharmacological therapy for acute pain. Many of the pharmacy improvements begin with a hospital Pharmacy and Therapeutics (P&T) committee, which makes recommendations for hospital-wide guidelines pertaining to medications. To this end, it is important that an APM physician maintain a presence on the P&T committee to learn about new evidence regarding pharmaceuticals, understand the perspectives of other stakeholders, and offer consultant-level input toward applicable decisions. Pharmacists also supply and secure appropriate concentrations of local anesthetics, assist with safe medication label design, account for controlled substances according to government regulations, design safe infusion practices, and provide sterile preparation of customized local anesthetic solutions for infusion and other processes in which safety depends on the intelligent design of the underlying system.

Pain Nurse Specialists

Nurses play a vital role in the modern APM team. The simple provision of a nurse dedicated to the care of patients suffering from acute pain throughout the hospital has been shown to decrease the incidence of moderate to severe pain, reduce the side effects of PCA and epidural analgesia, and increase patient satisfaction with pain control [127]. Nurses caring for patients in acute pain have been referred to as acute pain nurses, clinical nurse specialists, or pain resource nurses. Regardless of the title, or the hospital in which these nurses work, several mission commonalities can be identified:

1. Interface with bedside RNs caring for patients suffering from acute pain.
2. Education of patients and nurses on acute pain topics.
4. Data collection for administrative and quality-improvement efforts.
5. Direct provision of complementary and alternative medicine therapies and support of APM interventions.
6. Encouragement of specialty training for nurses in available pain nursing curricula.

Peer Support

The APM nurse facilitates a bidirectional dialog between ward nurses and the rest of the APM team. Frequently, this is reflected in the process of adapting general protocols to specific patients with varying needs. In this setting, the APM nurse assists the bedside nurse in optimizing patient comfort within the bounds of the prespecified pain management protocol. The APM nurse also facilitates communication with physical and occupational therapists, social workers, clinical psychologists, and other health care professionals whose interactions with the patient are modified by acute pain. This familiarity with nursing practices also assists APM nurses in their role as educators of patients and other nurses.

Hospital Pain Committee

In order to continually refine pain management across the wide variety of stakeholders present in modern health care systems, a hospital-wide pain committee should hold regular meetings to review and discuss the issues and initiatives. Critical representatives include pain specialists from the APM team, chronic pain medicine team, surgical
and medical subspecialties, nursing, pharmacy, physical and occupational therapy, administration, central supply, quality improvement, and information technology. Trainees may be invited to both learn more about pain management practices at the systems level, as well as offer innovative solutions to ongoing issues. Patient representatives may offer important insight from the most valuable perspective of all: that of the acutely pained patient for whom existing remedies proved lacking.

Education

Considering the number of available pain medications, interventions, complementary and alternative medicine therapies, and modifying factors, APM nurses must spend a large portion of their time engaged in educational efforts. Frequently, this translates into education of new nurses in pain management protocols, types of interventions, operation of infusion pumps, and expectations for results of each acute pain therapy. These same educational sessions are often given for patients, with evidence suggesting that such education may lead to decreased postoperative pain. Educational programs have been demonstrated to improve pain assessment, the rational prescription of opioids, and the overall effectiveness of the opioid-based treatment of pain either by interval dosing or via PCA [127–129]. The efficacy and side effect profile of epidural analgesia are also improved following the introduction of formalized educational programs [130]. The education of patients discharged with perineural or paravertebral catheters for home use perhaps best exemplifies the importance of patient education in acute pain management interventions. In this circumstance, the patient is clearly enlisted as a partner in the management of his or her own pain and must be educated accordingly.

At regular intervals, entire wards of nurses must be updated as protocols and practices change when new evidence becomes available. At the University of Florida, the University of Pittsburgh, and the University of Louisville, the APM nurses also serve as educational resources for housestaff and fellows rotating on the APM service. Their continuity offers an important counterweight to potential limitations such as the alteration of infusion pump settings, removal of perineural or neuraxial catheters, and the use of anesthetics for analgesic reasons, such as with ketamine. These issues do not necessarily reflect a limitation of nursing per se, but rather local training paradigms, the number of administrative tasks that must be performed by the modern APM team is innumerable and growing annually. From staff scheduling to ensuring the completeness of billing paperwork, the continuity of pain nurse positions is essential to managing these responsibilities. The APM nurse is also well suited to data collection tasks for quality improvement and/or research activities. These data collection tasks can either be undertaken directly or via coordination with a nursing representative from each ward.

Direct Patient Care

Currently at our institution, among others, the APM nurse participates in daily rounds and consults, and directs the care of nearly all patients on the APM service. Indeed, the APM nurse is frequently the institutional expert in the provision of CAM therapies. Beyond the pain scores and assessments documented by ward nurses, the APM nurse may often have qualitative information about the patient via the ward nurse that can help put quantitative pain assessments in perspective. Depending on the training background of the APM nurse, he or she can also assist with the initiation of pain therapy, such as ketamine infusions, or with the management of side effects.

Limitations

The role of the acute pain nurse is dependent on local training paradigms as well as scope-of-practice regulations at the governmental and hospital levels. For instance, while nurses may certainly assist patients with patient-controlled epidural analgesia boluses, concerns exist over independent nurse bolusing of epidural catheters with a local anesthetic. Many of these concerns are based on the need for physician orders for such boluses, as well as the possible need for prompt hemodynamic support, including the use of large, yet appropriate, doses of vasoactive substances to avoid cardiac arrest. Other potential limitations include the alteration of infusion pump settings, removal of perineural or neuraxial catheters, and the use of anesthetics for analgesic reasons, such as with ketamine. These issues do not necessarily reflect a limitation of nursing per se, but rather local training paradigms, licensure requirements, and scope-of-practice laws.

Protocol Standardization

In concert with the director of APM, the APM nurse assists with the design of protocols for pain assessment and intervention. These protocols are usually not just procedure specific, but must also be modified to account for variance in age, health care environment, patient cognition, and health status. The APM nurses ensure that such protocols reflect realistic principles that can readily be implemented by bedside nurses. Their input in the design stage enables them to better educate other nurses on the rationale behind the protocol.

Administrative Tasks

The number of administrative tasks that must be performed by the modern APM team is innumerable and growing annually. From staff scheduling to ensuring the completeness of billing paperwork, the continuity of pain nurse positions is essential to managing these responsibilities. The APM nurse is also well suited to data collection tasks for quality improvement and/or research activities. These data collection tasks can either be undertaken directly or via coordination with a nursing representative from each ward.

Block Nurse Specialists

Separate from the role of the APM nurse specialist are nurses with training in preoperative assessment, postanesthesia care, and sedation who can assist with nerve block placement. These nurses can assist with the preoperative preparation of surgical patients, which must be completed prior to sedation of the patient. Block room RNs then assist with the sterile preparation of nerve block equipment and supplies, provision of preemptive MMA,
and sedation and positioning of patients. This subspecialty of nursing requires a thorough understanding of the nature of the nerve blocks utilized, facility with US equipment, nerve stimulator use, and the common adjustments of equipment settings during nerve block placement. Beyond the procedural training, block room RNs must be able to recognize and initiate treatment for block-related adverse events. While many block room RNs also provide cross-coverage in the preoperative holding area or PACU, these nurses commonly also travel to hospital wards, ICUs, or ORs to assist with block placement. In our experience, the number of block room RNs needed is an "n+1" model, where n equals the number of simultaneous blocks and a "+1" is the nurse needed to set up equipment for the next block, care for the next and/or previous patients, and perform various administrative tasks. We reiterate the value of having block room RNs cross-trained to cover the preoperative holding area or PACU to minimize directed block room costs (Figure 2).

**Future of APM**

Despite the surge in acute pain management techniques and modalities, recent reports have shown that up to 41% of postoperative patients experience significant acute pain and 10–50% of patient reporting chronic postsurgical pain [92,131,132]. This alone justifies an infrastructure that supports an APM service that ensures the proper and timely measurement of acute pain, the availability of interventional analgesic techniques, which propagates education, and chooses appropriate evidence-based analgesic pathways in a standardized fashion [133,134]. Thus, the future of APM first begins with recognizing the essential infrastructure required to tackle such a significant issue.

While the objective infrastructure of APM is clearly justified, the continuum of acute pain in the surgical and nonsurgical arena must be embraced. Recently, this type of philosophy has been termed "preventative analgesia," which focuses on the evaluation/treatment of acute pain in all surgical phases (preoperatively/intraoperatively/postoperatively) in hopes of preventing chronic pain and debilitation once the initial painful stimulus has passed [89,132]. This notion emphasizes the possibility that the suppression of central sensitization may require a targeted therapy that blocks pain signaling from, or before, the time of injury to the final healing [132]. Though described in the perioperative period, this concept extends to nonsurgical
pain, as acute pain occurs in a variety of specific scenarios, and early aggressive treatment extended for a certain period of time may influence the incidence of chronic symptoms. This paradigm will allow future research to focus on the patient as a whole, with a particular focus on preoperative risk factors (preexisting pain, psychological measures, etc.), intraoperative occurrences (surgical technique and utilization of pain modalities), and postoperative rehabilitation (continued analgesic therapy and neurophysiological assessments). Notably, much research has suffered from design flaws, such as the absence of a true placebo arm or focusing only on preincisional vs postincisional interventions [89].

APM must also address how inconsistent “measurements of success” are reported within the literature [135]. Clearly, pain scores and opioid usage are only two small measures; further validation of patient satisfaction, hospital stay, tolerability of physical therapy, quality of sleep and mood, or sedation should be studied as possible measures that may contribute to chronic disability secondary to pain. Bedside measurements that can elucidate trends, such as the Defense and Veterans Pain Scale and Supplemental Questionnaire, which focus on indices such as mood, sleep, and level of stress, may become standard in addition to the traditional numerical pain scales (Figure 3).

Figure 3 Defense and Veterans Pain Rating Scale [136].
Recently, in the United States, much attention has been focused on patient satisfaction with pain control. Two pain-related patient satisfaction metrics are measured in the HCAHPS survey, the scores of which may be used to determine hospital-wide reimbursements by the Centers for Medicare and Medicaid [137,138]. Such future research will continue to consider acute pain a disease unto itself and not simply a postoperative symptom.

While APM must broaden its view of acute pain in the form of pre-pain/pre-intervention risk stratification extending through the phase of subacute pain, specificity for surgery and condition must be sought as well. As noted by White and Kehlet, certain surgeries have specific pain characteristic and subsequent impact on rehabilitation [139]. Future studies must establish procedure- and condition-specific analgesic regimens that not only consider the uniqueness of the condition, but the temporal nature of pain and, in turn, study the effect of the continued use of such analgesic regimens outside of the classic perioperative setting. In order to further understand interindividual variability, the pharmacogenomics of acute pain must also be embraced. Numerous studies have demonstrated a clear association with various genetic polymorphisms and the expression of pain, as well as a response to various analgesic modalities [140–143]. Additionally, behavioral and social differences are affected by, and exert influence on, the underlying genetic and other biologic substrates. Such a predictive capability would not only enhance risk stratification, but would also optimize tailored analgesic regimens to maximize outcomes.

Conclusion: APM as an Individual Specialty

Based on the depth, breadth, and scope of the burgeoning explosion of research and knowledge of the treatment of acute pain, we see very soon the need to establish APM as a subspecialty of anesthesiology akin to the chronic pain specialists. The crevice that exists in the diagnosis and treatment of acute pain dictates this development just as palliative care, addictions medicine, and others have developed. It is surprising that this gap has not been filled for such a long period but gratifying to know that this bridge is now being developed. As the field of anesthesiology evolves into the field of perioperative medicine, residents and the like must be instructed on the disease process of acute pain and not just the tools of RA. More importantly, collaboration among surgeons, primary care providers, nurses, etc. is essential to establishing APM not simply as a viable option, but as a necessity in any hospital setting. With this in mind, the field may push forward and serve its role in the pain continuum that we battle every day.

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References


36 Ready LB. How many acute pain services are there in the United States, and who is managing patient-controlled analgesia? Anesthesiology 1995;82(1):322.


44 Harmer M. When is a standard, not a standard? When it is a recommendation. Anaesthesia 2001;56(7):611–2.


88 Institute of Medicine (US) Committee on Advancing Pain Research, Care, and Education. Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research. Washington, DC: National Academies Press (US); 2011.


91 Press Ganey, ed. Hospital pulse report. 2009 [Internet]. Available at: http://www.pressganey.com/Reports/Hospital_ 

Evolution of Acute Pain Medicine


88 Institute of Medicine (US) Committee on Advancing Pain Research, Care, and Education. Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research. Washington, DC: National Academies Press (US); 2011.


91 Press Ganey, ed. Hospital pulse report. 2009 [Internet]. Available at: http://www.pressganey.com/Reports/Hospital_


103 Bennett MI, Hughes N, Johnson MI. Methodological quality in randomised controlled trials of transcutaneous electric nerve stimulation for pain: Low fidelity may explain negative findings. Pain 2011;152(6):1226–32.


118 U S Department of Health and Human Services DHSS PHSAFHCAPAR. Acute pain management: Operative or medical procedures and trauma. 1992.


