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Economic Considerations of Acute Pain Medicine Programs

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Summary

Acute pain medicine services influence many different aspects of postoperative recovery and function. Here, we discuss the various stakeholders of an acute pain medicine service, review the direct and indirect impact on said stakeholders, review the shared and competing interests between acute pain medicine programs and various payer systems, and discuss how APM services can help service lines align with the interests of the recent CMS Innovations Comprehensive Care for Joint Replacement Model.

INTRODUCTION

The interface of pain and economics remains difficult to assess due to the wide range of interpretation and valuation of acute postoperative pain. Nevertheless, the impact of postoperative of pain upon many different facets of postoperative recovery and function are difficult to ignore. Here, we first review the economics of acute pain medicine service from the perspective of different stakeholders, followed by consideration of the direct and indirect effects of acute pain medicine programs on said stakeholders. Next, we offer a general overview of modern payer systems in the US healthcare system and discuss different aspects of valuation of acute pain medicine programs by these reimbursement structures. We summarize this discussion by reviewing the central tenets of the Comprehensive Care for Joint Replacement Model designed by the Centers for Medicare and Medicaid Services' (CMS) new Innovation program and discussing how our institution has modified its care pathways to align with this program.

STAKEHOLDERS

Discussing the business aspects of a well-run acute pain medicine (APM) service is, to a degree, a matter of perspective. As such, it is important to define the stakeholders in such a service and how each of them is affected by the existence of the APM service.

Patients

At the core of any well-run acute pain service will be the patient. Although it is difficult to place a dollar value on pain control after injury or surgery, other benefits of pain management have been explored to varying degrees. Data are limited, but cost savings have become evident in terms of shorter intensive care unit (ICU) stays, decreases in risk of major adverse cardiac and pulmonary events, decreased risk of postoperative infections, a potentially reduced risk of the development of chronic pain, and perhaps even improved survival and decreased recurrence rates for some cancers, although this remains a controversial topic.¹⁻⁹ All of these outcomes offer not only cost savings, but an improved patient experience through better perioperative pain control, which, at least in the United States (US) model of healthcare finance, have a degree of impact on the patient directly, both in terms of the cost of their current admission as well as both short- and long-term costs.^{1,10,11} While individual patients have the potential to reap direct benefit, they are often partially shielded from the reality of costs, as most of those are borne by third-party payers such as insurance companies and government entities.

Hospitals

In addition to patients, hospitals are major stakeholders in the operation and utility of the APM service. Hospitals are directly impacted by the service's operational costs, revenue-generating potential, and potential cost-savings. In the minds of many surgeons and anesthesiologists, there exists a great deal of overlap between the concepts of the APM service and the provision of regional anesthesia (RA). There are many different models which can be used for the administration of regional anesthesia. In many facilities, regional anesthetic blocks are performed in the operating room. This approach has the advantage of only requiring the anesthesia team from the operating room for performance of both the blocks and the surgical case. Operating room placement of nerve blocks can lead to surgical delays and inefficiencies in the schedule of the OR staff, as surgery cannot commence until the RA block has been placed and given the sufficient onset time necessary for surgical anesthesia. This situation, by its nature, produces implicit, or even explicit, time pressure on the involved anesthesiologists, contributing to the risk of failed blocks. Any resulting, unacceptably high rate of secondary regional anesthetic blocks failure, combined with the imposed time delay, may cause surgeons to shy away from RA techniques for their operations altogether, despite the numerous benefits to the patient as outlined above.^{12,13} The model which seems to be gaining in popularity for the provision of high-quality RA and APM services is a dedicated facility with procedure rooms where RA services can be performed in parallel with activities in the operating room by an experienced regional anesthesiologist.¹⁴⁻¹⁶ This requires either exquisite timing in the placement of single-shot blocks, or the development of a high-reliability catheter-based skill set by the regional anesthesiologist. The block room model is likely less than ideal for low-volume RA/APM services, as the resources required to operate such a facility can increase costs while offering potentially negligible enhancements to overall efficiency. There are myriad other models which can be used, and ultimately what is likely most important is that the method used to deliver RA/APM services be tailored to the institution, resources, and personnel where the services are to be delivered.

While allocation of a formal blockroom can decrease delays and increase operating room efficiency in settings where RA is commonly used, it will also mean that the hospital must incur the cost of dedicating space to the RA/APM service mission. Likewise, there will be costs associated with staffing this environment such that specially trained nurses and techs are available in sufficient numbers to provide safe, effective, high-quality care to the patients being treated in these procedure rooms. Notably, allocation of these processes and resources must occur at some point during the perioperative continuum. The standard preoperative patient preparation can be joined and, to a degree, overlapped with a block procedure room. Such dual-use of preexisting space and resources requires only incremental improvements, rather than entirely new resource allocations.

Dedicated block room space can also provide a source of revenue to the hospital, as there would be facility fees associated with procedural care provided in this environment, just as there would be for any other procedure space, such as the GI endoscopy suite or cardiac catheterization lab. The challenge for the hospital lies in ensuring that the block procedure room is sufficiently spaced, equipped, and staffed so that RA services can truly be provided in parallel with operating room services, yet not to provide so much space or staffing that they are idle. When done correctly, there is no reason the block procedure room itself should become a source of delay, as would be likely if the space allocation is insufficient or understaffed,

Another factor which is becoming increasingly impossible for hospitals in the US to ignore is the linkage of patient experience scores, e.g. Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS), with hospital reimbursement via value-based purchasing programs. The perception of the adequacy of their pain control is examined directly in the HCAHPS scoring system—three of the 32 questions directly examine perception of adequacy of pain control from the patient's perspective.^{17–20} In an effort to combat the ever-growing opioid epidemic plaguing the US, the Centers for Medicare/Medicaid Services (CMS) announced in November 2016 that they will be dropping these questions from the HCAHPS survey over widespread fears that they contribute to the overprescribing of opioids.²¹ As such, the perception of poor management of patient pain is less likely than it recently was to factor into hospitals directly losing revenue from poor HCAHPS scores, but as long as the US healthcare market operates on a competitive, for-profit model, patient reports to their peers about their hospital experiences will influence how patients choose from which hospital they will receive services in the future, and this will certainly affect revenue.²²

Public

The other major stakeholder that must be considered is the public. Given the constant concerns about rising health care costs, it is imperative that methods to contain costs that extend beyond relatively ineffective carrot-and-stick methods thus far employed by government agencies such as CMS need to be explored. Multiple studies from countries including Taiwan, India, and the US have all consistently found that regional anesthesia-based approaches to operations as diverse as colorectal surgery, anterior cruciate ligament repair, total knee and hip arthroplasties, breast surgery, and carotid endarterectomy

demonstrated faster recoveries, decreased side effects such as post-operative nausea, shorter hospital stays, and decreased overall costs when compared to general anesthesia and opioid-based approaches.^{23–29} Similarly, the public has great interest in containing the evolving disaster that is the US opioid epidemic. With approximately 10 million Americans reporting using opioids for non-medical reasons, nearly 2 million meeting substance abuse diagnostic criteria for opioids, and as many as 91 deaths every day due to opioid overdose, it is imperative that effective methods for opioid-sparing pain control be employed whenever possible.^{30,31}

ACCOUNTING FOR DIRECT AND INDIRECT BENEFITS OF APM SERVICE FUNCTION

An appropriately structured APM service offers a number of direct and indirect benefits to patient care. While many of these evidence-based benefits are directly measurable, many others contribute to perioperative care in softly characterized manners that are difficult to assess. For instance, the capability to provide episodic palliative care interventions may not be a performance metric in certain systems that do not have formalized palliative care programs. Still, the incremental value of such palliative care interventions can improve this particular continuum of care in ways that are often self-evident within the episode of care. Another example of system-level direct and indirect benefits that spans multiple stakeholders involves the use of ambulatory continuous nerve block (CPNB) strategies for an ever-expanding list of eligible surgical procedures.^{32,33} Ambulatory CPNB extend the potential for appropriate analgesia with opioid-minimization into a pathway that may avoid the rebound pain following hospital discharge that has been identified in multiple perioperative surveys over the past decade.^{34,35}

Table 1 provides an overview of many indirect and direct benefits of modern, well-implemented acute pain services. These benefits cover multiple domains ranging from direct reduction in measured pain intensities to associated improvements in general patient wellbeing that are often inferred from minimization of opioid requirements. Moreover, the evidence supporting the role of APM service interventions in minimizing complications associated with surgery, while indirect, nevertheless carry consistent risk reductions and span the evidence-based gamut from basic science mechanisms to high-level epidemiologic studies replicated across many separate national and international healthcare delivery systems.

Perhaps one of the most recent reflections on the value of optimal APM service performance pertains to the opioid use disorder crisis gripping the USA. Within a hospital setting, the anesthesiology background of many APM service teams lends a certain familiarity and comfort in the targeted use of extremely powerful opioids. This could be expected to lead to the promotion of rampant opioid prescriptions given the low initial costs associated with their prescription and administration. Instead, our experience repeatedly demonstrates that mature APM service systems often aggressively minimize the use of opioid therapies via careful determination of the nociceptive mechanism, targeted use of evidence-based multimodal strategies, and selection of continuous perineural and neuraxial analgesic

interventions that anticipate the postoperative pain trajectory. While many public policy platforms on justice and public health align with these practices, it is important to note that these benefits are considered indirect as the costs and benefits are directly yet separately afforded to orthogonal aspects of financial accounting in our society.

PAYER MODELS

While the above material highlights the direct and indirect benefits of the APM service to multiple stakeholders throughout the US healthcare system, resource allocation remains inextricably linked to financial accounting. For many patients in the US, payment for healthcare services remains a complex affair; these complexities are shared by numerous other stakeholders, including those related to the APM service.

In general, perioperative healthcare is reimbursed according to one of several types of payer models.³⁶ The first category is the self-pay model, whereby the entirety of care is paid for out-of-pocket by the patient. Importantly, the cost of care is often not available to the patient beforehand; indeed, prior work has suggested that healthcare systems may be unable to offer reliable estimates of hospital charges beforehand, given the complexities in accounting for anticipated charges via chargemasters.^{37,38} This may also be quite true of anticipated costs for the APM service given the anticipated variance in both patient perceptions of nociception as well as response to analgesic interventions.

Managed care organizations comprise several different types of models including HMO, PPO, and ACO. Health-maintenance organizations were originally designed to manage healthcare costs in large part by bringing healthcare under the umbrella of a closed set of healthcare service providers.³⁷ In an HMO, care provided outside of the HMO's provider team is not covered. While this is often associated with lower deductibles and/or premiums, HMOs often carry the requirement that all subspecialty care must be accessed by first seeing a primary care physician. Preferred provider organizations (PPOs) allow for greater flexibility in choosing physicians and hospitals, but stratify benefit levels according to the network association of said healthcare services and are generally associated with greater premiums or deductibles. Perioperative pain management systems can indirectly complicate the experience and financial wellbeing of patients anticipating coverage from managed care systems where there are discrepancies in coverage and insurer participation between the hospital, surgeon, and APM service.

Accountable Care Organizations (ACOs) are comprised of groups of hospitals, doctors, and health service providers who coordinate their care both within and across healthcare encounters. ACOs were designed to control costs via increases in efficiency stemming from coordination of care as well as through tying payments to quality measures that should also reflect improvements from this increase in efficiency.³⁹ Theoretically, ACOs may be uniquely organized to recognize and act upon differences in cost-related decisions, which optimize short- versus long-term patient outcomes by capturing an extended range of disease management facets impacted by APM service interventions.⁴⁰

The third general category of healthcare payer is government-based and is largely comprised of Medicare and Medicaid.³⁶ Medicare provides varying levels of coverage for hospitalized care (Part A), outpatient care (Part B), and prescription drugs (Part D). Reimbursement for Part A services is based upon a set amount of money for each hospital encounter and is determined by the diagnosis-related grouping (DRG) under which the primary diagnosis of that encounter falls. Medicaid is a government-sponsored social healthcare program that is described by the Health Insurance Association of America as “government insurance program for persons of all ages whose income and resources are insufficient to pay for health care.” Medicaid is implemented on a state-by-state level using a combination of state and federal funds.

The type of payer plays a critical role in aligning strategic reimbursement objectives with the APM goal to promote long-term functional recovery through alleviation of acute pain. Prior work suggests nearly 20% of patients with managed-care payers are likely to change their managed care provider each year, and this inconsistency is associated with suboptimal provision of preventative care that could be costly in the near-term but offers substantial savings in the long-term for certain managed care arrangements.⁴¹ In contrast, other payer arrangements likely to maintain long-term longitudinal responsibility for patient care may be heavily incentivized to consider long-term horizons of cost-utility and cost-effectiveness.

Given the recognition of the \$635 billion annualized cost of chronic pain in the US, and the association of chronic pain with early high-intensity acute pain following injury or surgery, a number of clinical and research stakeholders have turned attention toward a potential inflection point in the early postoperative period that could mediate this association.^{42,43} However, the authors are unaware of any studies examining the potential, or even theoretical, economic relationships between cost of therapy for theoretical acute pain interventions and long-term cost-savings that could stem from decreased incidence and severity of chronic pain. Recent public debate has also focused on the incredibly challenging issue of widespread opioid use disorder that in large part stems from opioids prescribed following surgery.^{2,44–46} Indeed, work by Goesling and others has demonstrated a much longer duration and consistency of use of opioids following common orthopaedic surgeries than commonly anticipated, often associated with transformation of use patterns from treatment of postoperative pain to treatment of extra-surgical maladies; other related work has demonstrated substantial negative impact of preoperative opioids on postoperative recovery across a range of surgical models.^{2,47–50} Economically, this phenomenon further highlights how seemingly cost-effective short-term solutions can lead to drastically increased long-term costs. These costs are often transferred to others within the community and extend beyond healthcare costs to other societal concerns such as law enforcement, employment, and even defense; the cost-effectiveness discussion is thus not constrained to the individual patient, but bridges the conceptual boundaries between personal and population health.

Healthcare delivery systems represent another critical aspect of the economics surrounding acute pain medicine programs. As payers move from fee-for-service to value-based and bundled purchasing programs, delivery systems whose budgets are based on volume of services may face organizational constraints in adapting to varying integrated quality measures. In a department-style organizational system, these equate to unfunded mandates

that can lead to attempts to cost-shift to other departments or silos. Such misalignments have led several healthcare systems toward service-line arrangements, whereby care is coordinated across a continuum, and integrated across multiple stakeholders.^{51,52} For instance, instead of separate Departments of Orthopaedics, Anesthesia, Physical Therapy, and Nursing, a service line for orthopaedic trauma may integrate specialists from each of these areas into a unified reporting and budgeting structure.

In this model, acute pain medicine groups are thus positioned to provide for increased continuity of care extending well beyond the intraoperative portion of care. While many current anesthesia reimbursement systems are focused upon intraoperative tasks, the service line model emphasizes potential value by the APM team across the perioperative gamut. In preoperative assessment, the APM team can adjudicate options for regional versus general anesthesia to minimize day-of-surgery cancellations as well as manage preoperative expectations and provide for preemptive psychosocial interventions (e.g. identifying and intervening on behavioral risk factors forecasting adverse pain-related postoperative outcomes). In the immediate pre/intra/postoperative setting, APM services can coordinate regional anesthetic interventions designed around comprehensive improvements in patient and clinical outcomes rather than emphasizing volumes of procedures that may focus on near-term benefits at the cost of longer-term improvements to care (e.g. single-injection versus continuous and modular nerve block strategies). The APM service carries perhaps its greatest potential value in the postoperative setting by tailoring analgesic therapy to optimize functional recovery rather than simply minimize pain intensity. This purview thus places the APM program external to the perspective of a departmental organization that focuses only on intraoperative fee generation to the neglect of the potential impact of APM services on other critical elements in longitudinal patient care.

Importantly, the departmental model of APM integration also carries a number of benefits. In academic settings, the departmental model allows the organization to address research and educational missions within the specialty, as trainees generally focus at some point in their training on specialty care rather than the longitudinal organization of service-line arrangements. Similarly, some types of focused basic science research may be optimally resourced within a departmental arrangement. Departmental alignment can also improve efficiency in perioperative care by permitting flexibility in staffing via cross-training, allowing increased elasticity in accommodating day-to-day fluctuations in relative distributions of volumes across multiple service lines. Finally, departmental organizations can minimize liabilities inherent to overly-hierarchal leadership structures, providing a system of safety checks and balances.

IMPACT OF THE CMS INNOVATIONS CJR PROGRAM

In any hospital setting, total joint arthroplasty (TJA) remains a significant driver of the economic health of the institution. TJA offers hospitals the economic advantages of being elective, predictable, efficient, and well-reimbursed; as such, TJA regularly creates predictable margin and net income and has substantial impact on the health system's bottom line. Acute pain management services play an important role in this service line, and thus

there is significant economic overlap between a hospital's APM service line and its TJA service line.

In our own institution, there has been not only a consistently high volume of TJA, but also consistent growth. From 2012 until 2016, we experienced an 86% increase in total hip and knee arthroplasties; in 2017 we expect an additional 20% growth, more than doubling the amount of arthroplasties to over 1,000 per year within only 5 years (institutional data). The continued growth of TJA is fueled not only by the aging of the population, but the continued demonstration of the cost-efficacy of TJA—not only adding quality-adjusted life years (QALYs), but also improving pain and function and allowing people to return to work.^{53,54} As a result, health policy makers, insurers, and employers continue to consider TJA a cost-effective surgery and expect to continue to provide a progressively higher number of these surgeries as the population ages.

As noted above, TJA provides a predictable margin around which hospitals can make firm economic plans. In our own institution, the average margin associated with primary total hip and knee replacement, in 2017 dollars, approximates \$6,000 to \$9,000 per care episode, depending on surgeon and payer mix (institutional data).

Medicare remains the primary payer for TJA in the United States, accounting for about 40% of all TJA admissions, both in our own institution as well as nationally. The average reimbursement associated with TJA from Medicare across the United States in 2011 was \$14,300, with a range from \$9,100 to \$38,700.⁵⁵ At our own institution, the cost of post-acute care services represents an equivalent expense to the anchor admission, with both accounting for about 45% of the 90-day cost. The professional fees, on the other hand, represent slightly less than 10% of the cost of an episode and pale in comparison to the expense associated with discharge to any location other than home.

The literature continues to reveal that the majority of variability in 90-day cost comes from post-acute services, with higher spending health systems using a much higher percentage of skilled nursing or inpatient rehab facilities (SNFs or IRFs).⁵⁶ Surprisingly, recent literature has suggested that discharge to home is less likely to result in infection, readmission, or reoperation in the first year compared to discharge to one of these facilities, even when controlling for medical complexity and socioeconomic status.⁵⁷ As such, controlling for factors that predispose patients to SNF or IRF discharge is not only more favorable from a cost standpoint, it also leads to better patient outcomes.

Because of the high numbers of these procedures being performed annually, as well as the substantial associated expense, primary TJA has been targeted by CMS as an opportunity for cost savings in the annual health care expenditure budget. Additionally, TJA was recognized as an opportunity to embrace a value-based care approach in order to move away from a traditional “fee-for-service” billing model. With a high volume of procedures, CMS wished to drive costs down as well as identify and reward centers that consistently provided excellent outcomes in a cost-effective way. The first iteration of this new billing model was the Bundled Payment Care Initiative (BPCI), a voluntary participation program for hospitals to receive a single payment that would cover the entire cost of the care episode. It would be

up to the health system to distribute that payment across the spectrum as needed, with the goal of aligning disparate services to maximize cost-efficacy.^{58,59} Notably, this differed from a prior model that involved bundling DRGs; this model focused on the costs related to the procedure and immediate post-operative admission; post-discharge costs were considered independently.

In 2016, CMS announced the next iteration of their value-based purchasing billing model, the Comprehensive Care for Joint Replacement (CJR) model, a non-voluntary, forced participation model for 67 metropolitan service areas (MSAs) throughout the United States. Under the CJR, all Medicare A and B patients who undergo a primary total hip or knee arthroplasty (DRGs 469 and 470) in any hospital included in these areas will be tracked through a 90-day period, with all expenses tallied. CMS will use institutional, national, and regional cost data to set a “target price” for the 90-day episode. If the expense of the care episode falls below the target, the hospital will be eligible to receive a disbursement of a portion of the difference as a reward from CMS. If the expense exceeds the target, however, the hospital will be forced to repay a portion of these costs back to CMS [<https://innovation.cms.gov/initiatives/cjr>]. The reimbursement is further adjusted to account for patient experience scores (e.g. HCAHPS) and postoperative functional outcomes as measured via metrics such as HOOS-JR/KOOS-JR, PROMIS Global Health, or VR-12.^{60–63} This approach asks the hospital to accept a substantial amount of financial risk for the whole care episode, with the possibility of financial reward if the hospital can demonstrate cost-savings.

The 90-day episode begins on the day of admission to the hospital and includes all charges associated with the hospitalization and the diagnosis code, ensuring that post-acute services are linked, as well. This cost accounting will include home care visits, outpatient physical therapy, and rehabilitation facilities. CMS also identified a group of medical and surgical complications to be tracked through the window. CMS also identified a group of medical and surgical complications to be tracked through the window, with penalties lowering the target per episode price, effectively penalizing hospitals with a high number of expensive readmissions or complications.

Of note, CMS did include certain quality metrics that lower hospital risk for repayment penalties and enhance opportunities for profit in the new model. These include metrics to track value-based systems, such as the systematic collection of patient-reported outcome measures (PROs or PROMs), as well as more traditional hospital-based quality measures. Particularly relevant to anesthesia providers is that the hospital will be scored on HCAHPS metrics, but these scores will be hospital-wide, not limited to the orthopaedic inpatient service, and will exclude the pain component of HCAHPS. Thus, hospitals that do inexpensive but low-quality work will not be rewarded; care must be cost-effective and high quality to lead to success in the CJR bundle.

Participation in a bundled-payment, value-based care billing model changes much of the calculus of caring for TJA patients. In these new models, each component of the service line must provide value, either in the short-term by improving recovery or leading to fewer perioperative complications, or in the long term by improving health-related quality of life

or increasing patient or implant longevity. Some interventions in this calculus failed to be cost-effective. Most notable among these have been post-acute care facilities. In most circumstances, their intervention does not justify their cost, and as such, they have been largely cut out from most high-quality, high-value TJA service lines.

Bringing all members of the service line to the table to discuss potential changes in practice is essential to ensure all members know the role they play and can benefit from the enhanced perspective afforded by listening to participants from all facets of the episode. Through our care redesign, with significant input from surgeons, anesthesiologists, therapists, and nurses, our primary goal was to demonstrate ownership of the whole care episode, from the initial referral and consultation, to surgery, to long-term functional outcomes. This redesign included enhanced preoperative education with the introduction of a “joint-replacement education program,” improved patient optimization, including use of a risk-stratification protocol as well as a “high-risk” anesthesia clinic visit protocol for patients who meet certain risk criteria but who are deemed likely to benefit from joint replacement, enhanced use of regional and neuraxial anesthesia, improved early mobility and PT/OT training, and improved nursing protocols to avoid unnecessary interventions. Altogether, these efforts incidentally aligned with broader efforts to promote ‘enhanced recovery after surgery’, or ERAS, pathways. The primary goal was to remain patient-centered, not just cost-effective. We hoped, through this approach, to also achieve reductions in length of stay (LOS), percentage of patients being discharged to post-acute care, and direct hospital cost, all while maintaining or decreasing all-cause readmissions and without sacrificing care of patients in need (i.e. avoiding “cherry-picking” practices of refusing high-risk patients). This last point was particularly critical, given the state-designated public service and safety-net roles of our academic institution.

Our redesign began with a “pilot period” from November 2015 through January 2016. On February 1, 2016, this expanded to the whole service line, allowing a 2-month run-in prior to the CJR launch in April 2016. We now have more than 1 year of data on the effect of this system-wide redesign. Including all patients under the DRG 469/470, which represent a primary, unilateral total hip or knee arthroplasty, including for patients with hip fractures, we decreased LOS from 4.0 days in the baseline period to 2.8 days in the redesign period. The number of patients discharged to a post-acute provider decreased from 38% to 19%. Average per-episode direct cost declined by 26%. Average time spent in the pre-op area increased by only 10%. The number of 90-day readmissions in both time periods improved from 7.5% to 5.1%.

It is worth mentioning that, in the CJR model, by holding a patient an extra day for further therapy, the hospital spends more to avoid post-acute facility use in the short-term, but is more cost-effective to Medicare. In the long run, the hospital is then eligible for a higher reimbursement. Thus, it is favorable from an economic standpoint to trade additional LOS to diminish post-discharge facility usage.

From a payer standpoint, these are dramatic changes. Based on our institutional data, the savings from decreasing discharge to post-acute care alone equates to over \$100,000 per 100 TJA episodes. With a conservative assumption of 1,000 annual total joint episodes, this

redesign is worth over \$1 million in annual cost savings. For the hospital, assuming a DRG-type reimbursement model, this has a dramatic impact on the cost-efficacy of the service line.

Though it is difficult to pinpoint specific facets of the care redesign that made the largest impact, we feel that the multidisciplinary approach allowed for wide buy-in, and led to a culture change throughout the APM service and TJA service line. Though patients spent more time in pre-op interfacing with the APM service, they ultimately experienced more rapid turnaround in functional recovery, being discharged to home earlier and more frequently. In essence, this process applied preventative series to the perioperative TJA setting, trading minutes or hours of preoperative assessment and intervention for days or weeks of postoperative stays and rehabilitation. This improvement makes for happier patients and has definitive impact on the bottom line for both hospital and payer.

Additionally, there are intriguing downstream iterative effects of this approach. For instance, by using a high percentage of indwelling nerve catheters and improving post-operative pain management, our “short-stay” program grew to include an outpatient TJA model where patients are able to go home on post-operative day 0 with a nerve catheter. From a patient standpoint, this may lead to lower complication rates in addition to financial favorability with lower co-pays. Moreover, it became possible to introduce a narcotic-reduced and narcotic-free program for some patients. From an APS standpoint, this program required considerable investment of time and effort in educating home care providers, educating patients, phone calls to track home catheter patients, and expense in providing pumps. This process has been transformative for many TJA patients, however, leading to shorter stays and less burden of opioid medications. From a public health standpoint, opportunities to curb narcotic use are particularly salient given the current opioid epidemic.

The comprehensive joint replacement program has forced a reevaluation of numerous aspects of clinical practice involving primary total joint arthroplasties. Our experiences strongly suggest that successful leveraging of acute pain medicine programs into practices that move beyond short-term focus on acute pain, and into long-term enhancement of recovery from surgery, offer substantial benefits to both patients and healthcare systems. Whether your hospital operates within a system where the fee-for-service model still dominates or participates in a value-based purchasing “alternative payment model,” there are substantial opportunities under both models of reimbursement for a well-executed acute pain service, in conjunction with orthopaedic providers, to contribute to the well-being of the patients as well as the hospital.

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TABLE 1

Direct and Indirect Benefits of Acute Pain Medicine Programs

Impact of APS and RA	Explanation	References
Improved patient experience	APS associated with improved patient experience, not only in pain control area but also in communications area, home recovery, hospital rating.	64–67
Improved postoperative pain control (lower reported pain intensity)	Wide range of studies demonstrating reduced pain intensity across an array of upper and lower extremity procedures. Reduced pain intensities accompanied by reduction in systemic opioid analgesics. Results reinforced by meta-analyses on topic.	68–71
Decreased opioid consumption	Regional anesthesia or systemic non-opioid modalities associated with minimization of severe opioid-related adverse drug events.	68–70,72
Decreased incidence of alteration of mental status, delirium, postoperative confusion, and cognitive dysfunction	Acute pain medicine programs can promote avoidance or minimization of general anesthesia, opioids, and heavy sedation.	73,74
Decreased incidence of nausea and vomiting	Associated with improved pain control, anxiety relief, and decreased requirements for opioids and general anesthesia.	72
Decreased postoperative ileus	Related to effects of epidural analgesia on a gut motility and blood flow, as well as indirect effects of decreased nociception and opioid consumption.	75
Decreased incidence of POUR	Of the available anesthetic/analgesic modalities, peripheral nerve blocks have the least effect on POUR.	76–78
Improved quality of sleep	Likely related to superior pain control and anxiety reduction.	68,79
Decrease in pulmonary complications	The use of regional anesthesia in patients with COPD is associated with lower incidences of composite morbidity, pneumonia, prolonged ventilator dependence, and unplanned postoperative intubation.	3
Earlier tolerance of physical therapy leading to better functional recovery	Regional anesthesia associated with improved knee flexion in the immediate postoperative period and 1 month after surgery with regional anesthesia compared with systemic opioid pain control. Results supported by separate findings demonstrating that immediate and long-term postoperative knee movement were significantly improved with epidural and peripheral nerve block compared with systemic pain therapy.	77,80
Preemptive and preventative analgesia	Coupled theories suggesting that pre-incisional timing of analgesics leads to greater efficacy (preemptive); certain analgesic strategies may lead to sustained improvements in pain management even following metabolism and elimination of the therapeutic agent (preventative).	81
Potential for decreased development of chronic postsurgical pain	Potential to decrease need for post-discharge prescription of opioid pain medication which may help combat the opioid epidemic by decreasing easy access to opioid medications	2,4,5
Lower incidents of VTE	Neuraxial anesthetic techniques associated with lower incidence of thromboembolic complications via multiple mechanisms.	6,74
Reduced transfusion rates	In THA, both spinal and epidural anesthesia associated with approximately 33% reduction in intraoperative transfusion rates compared with general anesthesia, likely due to decreased blood loss as a consequence of lower arterial and venous pressures.	6
Lower surgical wound infection rate	Sympathetic blockade leads to improved tissue oxygen delivery, permitting increased oxidative burst capacity of neutrophils. May also be related to reduction in perioperative immunosuppression and vasoconstriction. Demonstrated in both mechanistic and epidemiologic findings.	7
Developing evidence of lower cancer recurrence rates with regional anesthesia	Studies both in vivo and in vitro suggest several mechanisms by which cancer surgery might affect cellular immunity: stress response to tissue injury, general anesthesia, and selective immunosuppression by perioperative opioids.	1,8,82
Decreased PACU stay in ambulatory settings	Especially valuable for extremity surgery in high-turnover ambulatory settings where pain and nausea are major patient dissatisfiers, lead to prolonged PACU stay, and are a common reason for unplanned hospital admission.	83–87
Decreased overall hospital length of stay and readiness time for discharge	Superior pain control and better joint mobilization, implementation of ERAS protocols, and sending patients home with home catheters.	87–90
Decreased readmission rate for pain control	Due to utilization of <i>continuous</i> nerve blocks and multimodal techniques.	91,92

Impact of APS and RA	Explanation	References
Surgeon and hospital marketing in a community	For elective procedures in competitive markets, pain management and recovery profiles represent common outcomes of particular interest to patients.	93
Cost effectiveness	Potential for increased economic efficiencies via decreasing GA and opioid side effects, improving OR patient flow, shortening PACU stay, and decreasing in hospital (re)admissions.	86,87,92

APS, acute pain services; COPD, chronic obstructive pulmonary disease; ERAS, enhanced recovery after surgery; GA, general anesthesia; HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems; OR, operating room; POUR, postoperative urinary retention; PACU, post-anesthesia care unit; THA, total hip arthroplasty; VTE, venous thromboembolism