Rapid Recovery in Total Joint Arthroplasty

Contemporary Strategies

Giles R. Scuderi
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Preface

For a long time, total joint arthroplasties were performed as inpatient procedures at hospitals with length of stay extending to several days followed by transfer to a rehabilitation facility and later home health care. However, this trend has now changed with advances in surgical technique, anesthesia, and pain control. Rapid recovery programs have now reduced the hospital length of stay to less than two days for many uncomplicated cases, and there is also a movement to perform total joint arthroplasties in an outpatient facility, especially for younger and healthy patients. This change requires surgeons and administrators to implement the improved clinical processes and learn from successful programs to avoid unnecessary complications and readmissions. This emerging change in total joint arthroplasty is also driven by patients and payers, who desire to reduce their costs, increase convenience and satisfaction, and decrease the risk of postoperative complications. In addition, more hospitals are moving total joint surgeries to outpatient settings to compete with freestanding ambulatory surgery centers. Moving these procedures to outpatient facilities will have a financial impact on hospitals, especially as the Centers for Medicare & Medicaid Services (CMS) removes total knee and total hip arthoplasties from the inpatient-only list. Commercial health insurance companies are also implementing similar changes in the rules. These changes create new pressures on all the health-care providers in the system. Surgeons will need to collaborate with the hospital, and administrators will need to be agile to execute change. This text serves as a practical guide for each member of the team with insights by the leading authorities from around the country that have experience in rapid recovery and outpatient programs. While there is a move toward outpatient surgery, there is still a need for inpatient hospital procedures. Contributors will also provide information on differentiating the patient population. We are hopeful that readers will find this information helpful as they react to the changing world for total joint arthroplasty.

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Chapter 1
The Changing World of Total Joint Arthroplasty

Giles R. Scuderi

Introduction

The incidence of primary total hip arthroplasty (THA) and total knee arthroplasty (TKA) has been steadily increasing over the last few decades with over one million THA and TKA procedures performed each year in the United States. With the aging of the "baby boomers," the higher rates of diagnosis and treatment of degenerative arthritis, and the growing demand for improved mobility and quality of life, the incidence of THA and TKA will continue to rise, making these procedures the most common elective surgical procedures in the coming years [1–3]. It was observed that the number of adults in the United States undergoing TKA increased by 143% from 2012 to 2015 [4]. It is anticipated that future increases in both THA and TKA will occur in both inpatient and outpatient settings, although the majority of the growth is expected in the outpatient setting with only a modest increase in the inpatient setting [5, 6]. This shift to the outpatient setting is further supported by the 2018 Outpatient Prospective Payment System rule released in 2017 by the Centers for Medicare and Medicaid Services (CMS), in which TKA was removed from the inpatient-only list. In light of these changes, the orthopedic community of arthroplasty surgeons responded with the creation of safe and cost-efficient value-based outpatient programs that optimize patient management and manage all necessary components within the episode of care.

THA and TKA are some of the most common elective procedures, and both have led to significant improvement in health-related quality of life [7]. Unchecked with increased utilization, healthcare costs would rise exponentially. Curbing the continuing increase in healthcare costs has led to innovative cost- containment solutions. The fee-for-service model was targeted as a cause of the steady rise in healthcare spending because it provides incentive to provide more rather than

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better care. In 2013, the Bundled Payments for Care Improvements (BPCI) initiative was launched by CMS. This created a shift from a volume-based model to a value-based model that rewards value and quality encompassing the complete episode of care. As a separate but related value-based payment model, CMS introduced the Comprehensive Care for Joint Replacement (CJR) program. In addition, based upon the success and merits of the bundle programs, some of the nation's largest self-insured employers are aligning with centers that provide the highest quality and value of care. This value-driven model has also extended to patients who are now empowered with more information and data enabling them to make an educated decision on their healthcare. These alternative payment models continue to evolve and have facilitated a shift toward collaborative multidisciplinary team-based approaches to THA and TKA episodes of care that are patient-centered value-based systems. This new value-based model has the potential to provide an episode of care with little variation. These patient-centric programs strive to reduce nonessential operating room and hospital services; minimize adverse events requiring increased length of stay, readmission, and discharge to inpatient rehabilitation facilities; and ultimately better coordinate inpatient and outpatient services. This has also placed further burden on the hospitals to be more responsible for healthcare. The Affordable Care Act (ACA) introduced the Hospital Acquired Condition Reduction Program (HACRP) holding hospitals accountable for hospital-acquired complications. This is part of the Medicare pay-for-performance program, which supports CMS efforts linking payment to quality during inpatient stay and reduces hospital-acquired complications.

While these value-based programs have affected a deal of change, they are not without some unforeseen consequences. The issue with the CMS bundle programs is that they are neither risk stratified nor risk adjusted. Patients with chronic illnesses or multiple comorbidities require more services and extended care than healthier patients. Therefore, there is the potential for some surgeons or hospitals to "cherry pick" or "lemon drop" patients with multiple comorbidities [7]. Attention should be given not to exacerbate healthcare disparities as surgeons perform more total joint arthroplasty (TJA) on the healthier low-risk patients and limit access of surgery to the higher risk patients. Additionally, hospitals need to financially plan for the shift of the healthier patients to the outpatient setting, while the higher risk patients with chronic illnesses or multiple comorbidities undergo surgery at the hospital with longer periods of hospitalization and increased cost.

Navigating these situations requires clinical insight and administrative leadership. Effectiveness of the programs relies on the adoption of evidence-based practices and the support of surgeon champions. The arthroplasty surgeon needs to maintain responsibility for patient care throughout the episode, from the preoperative workup to the surgery to the postoperative care, including hospitalization and rehabilitation, home care, and finally office follow-up. A patient's risk for a negative outcome following surgery may be both predetermined and modifiable prior to surgery. This necessitates a redesign of total joint arthroplasty (TJA) programs with a surgeon-led multidisciplinary team consisting of anesthesiologists, internal medicine consultants, pain management, nursing, physical therapists, postacute

services, case managers, and hospital administration. The traditional model of a patient undergoing surgery after receiving "medical clearance" has evolved into a shared decision-making process with patient optimization managed by this multidisciplinary team. This team approach incorporates the entire episode of care with the intention of optimizing the patient for surgery with management or correction of modifiable risk factors, enhancing the recovery period with early ambulation, achieving adequate pain control, decreasing length of stay, reducing complications and readmissions, and increasing discharge to home. While most of the attention has focused on addressing preoperative modifiable risk factors such as smoking, malnutrition, and obesity, a recent study has shown that nonmodifiable comorbidities such as congestive heart failure, pulmonary circulation disorders, renal disease, cardiac arrhythmia, chronic pulmonary disease, and neurologic disorders have a greater impact on achieving the postoperative goals and may be more substantial contributing factors impacting the outcome of the surgery and the associated increased cost [8]. This is impactful since as programs further optimize the patient prior to or during the episode of care, "rapid recovery" or "fast-track" programs have become popular. These programs have significantly reduced the length of stay, and patients who meet appropriate criteria are discharged home either the next day or on the same day of surgery [9, 10]. What has also happened is that these rapid recovery programs have created a natural evolution from the inpatient to the outpatient setting [11–15]. While outpatient TJA is not a new concept, there has been a slow migration to wide acceptance because there is not a proven method for confidently identifying patients who can safely undergo outpatient TJA. The American Association of Hip and Knee Surgeons (AAHKS) in 2018 released a position statement on outpatient joint replacement. It is recommended that gradual and thoughtful changes in practice be influenced by defined quality metrics, including length of stay, readmission rates, complication rates, and general health of the patient population. This necessitates a thoughtful analysis of quality metrics by both surgeons and hospital administration. From a practical point, if a surgeon or hospital has a length of stay of 2 days or more following THA or TKA, it is not advisable that the surgeon or hospital begin performing outpatient TJA until they have gained experience in reducing their length of stay to less than 2 days. Reviewing institutional data, improving relevant metrics, and optimizing clinical protocols to maintain patient safety are fundamental to gaining experience. The essential elements required for a successful program include patient selection, patient education and expectation management, social support and environmental factors, clinical and surgical team expertise, and hospital or surgery center factors.

Patient Selection

With the changing milieu of TJA to an outpatient setting, establishing patient selection criteria is critical. The only way to ensure a consistent and manageable episode of care is to have every patient undergo a detailed risk assessment prior to surgery.

This information helps determine whether the patient is a suitable candidate for outpatient TJA or better managed as an inpatient. Currently, while there are recommendations, there are no universally accepted guidelines for risk assessment prior to determining which patient would be suitable for outpatient TJA. Previously established scoring systems used by the medical community have been used as surrogates for risk assessment. The American Association of Anesthesiologists Physical Status Classification System (ASA-PS) and the Charlson Comorbidity Index (CCI) have been explored for patient risk stratification, but their appropriateness for selecting outpatient TJA patients is unproven and their predictive value is low when evaluating TJA patients. With the need for a more arthroplasty-specific and predictive medical risk assessment score to safely select patients to minimize risk and optimize outcomes, the Outpatient Arthroplasty Risk Assessment (OARA) score was developed [11]. The OARA score was found to more accurately predict safe early discharge after TJA than the ASA-PS or CCI. Similarly, the readmission risk assessment tool (RRAT) is another method of risk stratification for patients undergoing TJA that is based on modifiable risk factors and comorbidities [16, 17]. The RRAT score has been associated with readmission after TJA but was not designed to identify patients at risk for perioperative complications that would necessitate readmission after outpatient TJA. Regardless of the risk assessment score used, significant predictors of adverse perioperative events include chronic obstructive pulmonary disease, history of cerebral vascular accident or transient ischemic attack, prior myocardial infarction or other cardiac surgery, hypertension, overweight body mass index, smoking, anxiety, and prolonged operative time. Accurate risk assessment that is performed prior to surgery is an essential component of safe patient selection for outpatient and early discharge TJA. Modifiable risk factors must be addressed preoperatively to optimize the patient for surgery and determine the planned clinical care pathway.

Patient Education and Management

An essential element in the clinical pathway is patient education with a clear understanding and alignment of both surgeon and patient expectations. The first step in the preoperative pathway begins with a clear and insightful discussion about length of stay and discharge disposition, as well as the inclusion criteria for outpatient and early discharge TJA. A preoperative multidisciplinary TJA education class is an effective method for introducing patients to the planned clinical pathway and to a total joint coordinator or case manager who is assigned to the TJA program. This is also an opportunity to ensure that the necessary staff and service line resources are available and are coordinated successfully. In addition to patient education, it is important that the patient has a home support structure, so a family or "coach" education program is essential and should outline the expectations and necessary home environment for an optimal and safe patient recovery following discharge. When applicable, the TJA coordinator should do a patient home assessment to make certain that the family member or home care provider is competent to tend to the

needs of the patient in the first 48–72 h postoperatively. The ability to identify and avoid potential challenges in the perioperative period following TJA is important for improving patient satisfaction, reducing complications, and ultimately providing improved value for the episode of care.

Since the early postoperative observational period is shifting to the home environment, same-day discharge and next-day discharge following THA and TKA necessitate closer patient surveillance after surgery. The patient must have adequate physical and social support during the early postoperative period at home and have full access to the medical and surgical team 24 h a day and 7 days a week until the patient sufficiently recovered. Rapid recovery programs have transitioned patient supportive care and guidance from the hospital staff to the surgeon's staff. Traditionally, during an extended hospital stay, there are a multitude of healthcare providers, including physicians, medical consultants, floor nurses, nursing aides, social workers, physical therapists, occupational therapists, and dieticians who interact with the patient. The process of "rounding" on patients after surgery to observe their recovery has changed. When patients leave the hospital on the same day or the next day, the burden of care during the postoperative period falls onto the surgeon, office staff, nurse navigators, home care service providers, and family [18, 19]. Most programs structure the postoperative management based on the resources available. The challenge is that as the need for postoperative resources increases with more individuals involved in the care, the cost increases and the value decreases. By deploying solutions like web-based navigation and education, telehealth, and asynchronous communication, programs can provide postoperative care more effectively. This is further enhanced by the adoption of a series of mechanisms to manage the early days following discharge, including nonstandard office or telemedicine visits on the early days after discharge, evaluation through home visiting nurse services, and close telephone conversations. Nurse navigators using digital formats such as web-based patient portals with smartphones, tablets, or computers can also perform virtual patient rounds. These nurse navigators provide a coordinated pathway for patients guiding discharge disposition and home needs [20]. Reports have shown that early engagement by these means has reduced patient emergency room visits, readmissions, and reoperations [18]. Digital services with nurse navigators help establish a TJA program that provides patient communication services during and after office hours [21]. The office staff, including physician extenders, secretarial staff and nurse navigators, who are trained on appropriate care, can address calls during the day, but TJA surgeons or surgical mid-level providers, such as nurse practitioners or physician assistants, should address after-hour phone calls. These providers can resolve the majority of after-hour calls with reassurance or advice, reducing visits to the emergency room. As mentioned above, web-based patient portals have been useful in navigating and guiding patients through the perioperative period with the potential for real-time communication with an enhanced recovery experience.

The introduction of digital technology has enhanced patient care. By offering targeted education, communication tools, and patient-reported outcome (PRO) collection, web-based portals encourage patients' engagement in their own care.

Web-based portals provide the ability to guide the patient through a personalized care plan, engage in real-time patient monitoring, and facilitate outcome collection. In the TJA population, web-based portals may serve the unique benefit of offering online physical therapy, allowing TJA patients to reach functional goals while reducing costs. Implementation of an online physician-patient messaging platform also allows patients to communicate with providers efficiently, enabling rapid follow-up for wound abnormalities or providing reassurance and preventing unnecessary visits for normal-appearing wounds [22]. Continued efforts are underway to build web-based patient platforms where patient optimization can be performed efficiently to generate individualized patient-centric programs that can be delivered via mobile applications and tracked within the electronic health record.

Multidisciplinary Team Expertise

A critical element in performing outpatient or early discharge TJA, whether in a hospital or in an ambulatory surgery center (ASC), is a capable and experienced medical and surgical team. The anesthesia team, surgical team, and recovery room nursing staff must be experienced and facile in perioperative pain control, fluid resuscitation, early patient mobilization, and medical management. Enhanced recovery after surgery (ERAS) is becoming a critical element in rapid recovery programs. ERAS is a multidisciplinary endeavor directed toward the modulation of the stress of surgery [23]. Chief components of the program are preoperative patient education to reduce anxiety and emotional stress, adequate multimodal analgesia, and early mobilization after surgery. Preoperative education most benefits patients with depression, anxiety, unrealistic expectations, and limited social support.

Recent changes in preoperative fasting and carbohydrate loading are impacting postoperative recovery. ERAS guidelines permit the intake of clear fluids until 2 h before the induction of anesthesia and a 6-h fast for solid food [24]. Guidelines also recommend that patients consume a clear carbohydrate-rich drink 2–3 h prior to surgery with the goal of the patient presenting to surgery in a metabolically anabolic state. While there is some controversy that preoperative carbohydrate loading contributes to an improved outcome following TJA, the risk versus benefits of liberal fasting and carbohydrate loading suggests that these concepts can be safely applied to TJA.

Multimodal pain management has become the standard of care for TJA [25, 26]. Pain management and anesthesia protocols tend to be a collaborative effort between the anesthesiologist and the surgeon with the goal of providing effective pain control; minimizing adverse reactions to the anesthesia, such as nausea; and allowing early and rapid mobilization after surgery. Regional anesthesia, peripheral nerve blocks, and periarticular injections have been effective modalities. Reduced length of stay is consistently associated with the use of neuraxial regional anesthesia versus general anesthesia. Multimodal analgesia techniques are individualized for each patient and may incorporate several methods of pain relief. The concern

about the opioid crisis had led surgeons to reevaluate the extended use of narcotics following surgery. Opioid use is decreasing in patients undergoing TJA, which may be in part due to an increase in multimodal analgesia, along with the use of non-narcotic medications. Improving prescribing practices, along with the implementation of governmental policies and registries, has further impacted postoperative opioid use.

Efficiency in the operating room centers on a choreographed approach, with each team member knowing his or her responsibility. Time is a valuable resource. A delay in the start time, a lengthy turnover, or time spent looking for missing equipment can impact operating room efficiency. Personal accountability, streamlining of procedures, interdisciplinary teamwork, and accurate data collection influence reproducible outcomes with minor variation. Efficiency leads to a reduction in the operative time, which ultimately has been shown to decrease the length of patients' stay [27].

Hospital and Ambulatory Surgery Centers

Rapid recovery programs have shifted some TJA cases from the inpatient to the outpatient setting with the establishment of dedicated ASCs. Performing outpatient TJA in an ASC requires an efficient and streamlined operating room and perioperative process, which should be validated within an inpatient setting prior to moving cases to ASC.

It has been shown that patient-related, procedural-related, and institutional-related risk factors have been shown to influence the length of stay following TKA [28]. Just like patient optimization, institutional optimization, standardization, and adherence to established clinical pathways are necessary for a limited stay or outpatient TJA. Aside from the surgical technique and anesthesia protocols, surgical staff training is vital for the success of outpatient TJA. The staff should be trained and should be competent with the surgeon's surgical setup, technique, and instrumentation. Operating room efficiencies should focus on surgeon preferences and procedure requirements to "right size" the instrument trays and limit the burden on central sterilization. It is also important that timely turnover of the operating room be performed to maximize utilization and patient throughput. When system processes are put in place, surgeon confidence, along with team confidence, increases. Standardization of surgical protocols decreases the setup time, reduces procedure time, and reduces the costs associated with instrument sterilization and central processing.

With the appropriate infrastructure in place and appropriate patient selection, outpatient TJA can be a safe, efficient, and cost-saving procedure for hospitals and ASCs. The financial implications are continuing to evolve with savings on both institutional direct and indirect costs with an ultimate reduction in charges. Recent reports have shown a decrease in charges to the patient and insurer with outpatient TJA without a significant increase in complications or readmissions [6, 29, 30].

With this shift of TJA to the outpatient setting, there is an anticipated increase in joint ventures between hospitals and ASCs. Hospitals will need to look at outpatient facilities to capture lost revenue as the inpatient volume decreases. Private equity firms have also begun to invest capital into ASCs, realizing that there is an opportunity to further expand the outpatient market. Regulatory agencies such as the Joint Commission and CMS have begun the review of the accrediting process for ASCs, and recently CMS has approved the performance of TKA in the ASC setting.

Innovative Technology

Over the years, new innovative technologies and implant designs, including new bearing surfaces, patient-specific instrumentation, computer and handheld navigation systems, intraoperative sensors, and robotics, have impacted the world of TJA. These new innovations have been scrutinized for their safety, efficacy, and cost-effectiveness. Since they almost always come with a substantial rise in cost compared to conventional techniques and predicate implant designs and the benefits of the technology may not be recognized for decades, surgeons, hospital administrators, and industries must analyze the business plan and restrategize their approach to the introduction of these technologies. This is especially important with the initiation of bundled payments that concentrate on short-term savings for the episode of care, newer and more expensive technologies are challenging the system. At the current reimbursement under bundled payments, advocates of innovative technologies will have to demonstrate the increased value to cover the increased cost. Within the competitive marketplace of TJA, surgeons may feel the pressure to be relevant by adopting new technologies requested by their patients or presented to them by industry representatives. Any new innovation needs to demonstrate its intended benefits. This can only be accomplished if surgeons document their results with satisfactory medical records and PROs. Innovative technologies will continue to shape TJA, but surgeons should not become dependent upon new technology.

Supply Chain Management

As part of a value-based care system, there is a need for a partnership between the surgeon and the hospital or ambulatory surgery center. The intention is to provide a standard of care and identify conversion opportunities, such as implants, innovative technology, medical supplies, and pharmacy products. Facilitating surgeon independence and encouraging the use of cost-effective products with clinically equivalent outcomes are core elements of a successful partnership. Once a standardized program is implemented, feedback and data analysis on the clinical, financial, and operational elements should be performed to assure efficacy and success.

Routine metrics should cover financial and operational elements of the program and continually look at opportunities for improvement and innovation. This can be organized with enterprise resource planning that provides an interactive view of operational activities, including implant costs, pharmaceutical costs, usage, and revenue cycle processes; a complete picture with the alignment of procedure costs with DRG reimbursement; and an alignment of the cost data with the clinical outcome data.

The Workforce Trends

Workforce management ensures that the right people are in the right place at the right time. In healthcare and in the treatment of the growing population of patients with arthritis, this is a complex process. Current orthopedic training necessitates a minimum of 10 years, from medical school to completion of an orthopedic residency program. In addition, fellowship training adds an additional 1–2 years, with specialty training. Planning for the future must take this into account, along with the changing patient population, since there is a well-documented increase in the number of patients suffering from osteoarthritis [31]. Moreover, one must take into account future changes in TJA as a result of an aging population, technologic advances, and demand for revision surgery.

As highlighted above, the number of TJA cases has sustained continued growth over the years. For this trend to continue, the skilled surgical workforce must meet procedural demands. The challenge is that despite the increase in TJA cases, the number of adult reconstruction surgeons is decreasing [32]. This can be potentially reversed by increasing the efficiency of surgeons per case, delaying the retirement of skilled arthroplasty surgeons, and increasing the complement of graduating residents with fellowship training in TJA. However, there is not a simple solution for this workforce supply-side dilemma. Governmental agencies, health care economists, and patients need to understand that the current number of arthroplasty surgeons will be unable to meet the TJA needs of the growing arthritic population [33]. There is no clear-cut solution to this problem. It has been postulated that some of the solutions are practical, and others are unrealistic or unlikely. These ideas include the following: (1) allow limited access to play out, but this will result in rationing TJA with long waiting times similar to those seen in socialized healthcare systems; (2) train more arthroplasty surgeons to meet the demand, but this would mean increasing the number of orthopedic residency and fellowship programs beyond the current complement; (3) increasing reimbursement for TJA would incentivize surgeons, but this goes counter to the current declining reimbursement for surgery; (4) with the increasing number of Medicare patients, allowing participating surgeons to balance bill similar to nonparticipating surgeons is appealing, but this would require governmental changes that are unlikely; and (5) a final proposal would be to change the certificate of need and specialty hospital regulations to allow the development of

high volume, efficient TJA centers [30]. The final solution has yet to be identified, but changes are happening. There has been a recent increased interest in adult reconstruction fellowships among graduating residents because of increasing employment opportunities and marketability [34]. This will help increase the complement of skilled arthroplasty surgeons. Another change is that while the majority of TJAs are still performed in an inpatient hospital setting, there has been a dramatic increase in the number of ASCs. Hospitals recognizing this shift have acquired or formed joint ventures with ASCs. This has also allowed for a three-way partnership between the hospitals, surgeons, and the ASC management organization. Physician-owned specialty hospitals and ASCs have also provided a financial incentive to move healthy TJA patients to the outpatient centers. Surgeons have begun to move patients to ASCs because of high quality of care, lower cost of care, and better reimbursement. Until there is financial neutrality, it may be more lucrative for some surgeons to perform TJA in an ASC. This has also created another dilemma: hospitals will acquire the "sicker" patients who require greater care in the perioperative period with higher costs. Hospitals participating in Medicare's mandatory and voluntary bundled payment programs for TJA are unsure whether CMS will ultimately adjust the payments to account for a higher proportion of sicker, higher cost patients remaining in inpatient units while healthier individuals move to outpatient settings.

Summary

In the coming years, there will be further changes to performing TJA. While CMS has already moved TKA from the inpatient-only list, there are plans to move THA from the inpatient-only list, making the procedure eligible for Medicare reimbursement in the hospital outpatient and inpatient setting. CMS is also proposing that TKA be added to the ASC-covered procedure list, expanding the surgeons' choice for the appropriate setting for the care of their patients. These moves by CMS reflect the strides that have been made in patient selection criteria and clinical pathways for patients undergoing TJA as outpatients in either hospitals or ASCs. It is also anticipated that commercial insurers will also follow the lead of CMS. Execution of outpatient TJA will require appropriate patient selection and education, efficient surgical technique with tailored anesthesia, excellent medical care, and coordinated postoperative care. Surgeons, hospitals, and ASCs will need to focus on patient experience with third-party metrics. However, the entire medical community, the government, and the insurers need to realize that both THA and TKA are complex procedures that are performed on a diverse sociodemographic patient population with varying age-related comorbidities. Improvements in surgical techniques and perioperative care have reduced the length of stay, but the criteria of discharge between inpatient and outpatient TJA do not differ. Medical comorbidities, social support, and environmental factors must be considered in determining the safest and appropriate setting for each patient.

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Chapter 2
Understanding Alternative Payment Models

Adam J. Schwartz and Kevin Bozic

Introduction

The appropriate method of payment to a physician for health care services is a debate that spans history. The oldest written reference to physician remuneration is considered to be the code of Hammurabi written in 2000 BC, which stipulated a payment of ten shekels of silver for specific surgical therapies [1]. The writings of Hippocrates reflect a conflict regarding physician payment, in some cases advocating for the practice of medicine without payment, and in others referring to appropriate payments for specific services. The Hippocratic oath itself refers to the practice of medicine as both an art and a science, implying a delicate balance between an activity done for pure righteousness and one for gainful employment [2].

The predominant method of payment for health care services in the United States has been on a fee-for-service (FFS) basis, meaning that each service is paid for separately and individually [3]. Under this system, fees have either been paid directly by the patient out of pocket or, after private insurance companies began to offer health care coverage in the early 1900s, through a third-party payer. Prior to July 1965, when Congress created Medicare under Title XVIII of the Social Security Act, almost half of patients over the age of 65 were without private health insurance coverage. Since that time, Medicare coverage has expanded on a number of occasions to include groups of patients for which it was not originally intended, including younger patients with amyotrophic lateral sclerosis (ALS), end-stage renal disease, and other chronic conditions, and is now the single largest third-party payer in the United States.

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As the US health care system continues to grow more rapidly relative to other segments of the economy, multiple problems associated with the FFS system have been recognized by policy makers [4–6]. Most notably, opponents of FFS models argue that the system is based upon volume and intensity of services rather than value delivered to patients, and as a result, there are no incentives for providers to reduce or eliminate wasteful spending and/or strive for optimal outcomes from the patient's perspective. Moreover, an FFS system may paradoxically reward poor outcomes as providers caring for adverse events or complications continue to bill for these episodes independently and in addition to the initial treatment. Finally, a system of separate payments for health care encourages the fragmentation of care delivery whereby independent providers have little regard for redundant or additional payments to other providers for services that may or may not be related. The net result of the FFS third-party payer model was the growing recognition that health care costs in this country are spiraling out of control.

Given the growing concern over health care costs, the political and economic conditions from 2007 to 2010 have encouraged and, in some respects, facilitated the most extensive health care reform in the United States since the enactment of Medicare [7]. On March 23, 2010, President Barack Obama signed the Patient Protection and Affordable Care Act (ACA) into law, with the aims of increasing access to care, reducing the cost of care, and improving the quality of care delivered [8]. Section 3021 of the ACA established the Center for Medicare and Medicaid Services Innovation Center (CMMI), charged with developing and studying alternative payment models (APMs) for physician reimbursement [9, 10].

While many alternatives to FFS exist, the most commonly employed and studied APMs are capitation (whereby a health care organization receives a fixed payment for its covered population, regardless of the volume or cost of care provided) and bundled payments (whereby providers are paid for the entire cycle of a single care episode rather than for each separate individual service). Capitation was popularized in the 1990s with the proliferation of Health Maintenance Organizations (HMOs), and today examples of this model abound with Accountable Care Organizations (ACOs), shared savings plans, and others now tied to specific quality metrics. Critics of the capitation model argue that while capitation may reduce costs at the population level, patients are less interested in population-based outcome measures compared to their own personal health, and providers have little control over the baseline health of the population that they serve. Furthermore, capitation has the potential to incentivize physicians to withhold care [4]. In contrast, proponents of bundled payment systems argue that such a system necessitates providers working together to provide treatment. In addition, as bundled payments are tied to specific outcome measures, the system holds the group of providers for any treatment episode accountable for delivering high-value care. Proponents also argue that the successful implementation of a bundled payment program demands a concrete understanding of the costs involved in delivering care, which will encourage the development of improved accounting methodology by health care institutions.

Bundled payments are not a new concept. The first use of a bundled payment was the creation of a comprehensive global fee for cardiovascular surgery at the

Texas Heart Institute in 1984, a program that succeeded in reducing costs, improving access to care, and maintaining preprogram patient outcomes [11]. Around the same time, Medicare, recognizing the need to move away from high variability in "usual and customary charges" for inpatient services, created the inpatient prospective payment system (IPPS) and began basing hospital payments for certain conditions on specific diagnosis-related groups (DRGs). While some argue that newer bundled payment models are similar to the currently employed DRG system, there are a number of important differences: (1) DRGs do not include payment for the full cycle of care (physician, postacute care), (2) DRGs are not tied to outcome measures, and (3) many important inpatient services are not included in the DRG payment, such as patient education and care coordination [4]. In a further step toward contemporary bundled payments, in 2009, the Centers for Medicare and Medicaid Services (CMS) (changed from the Health Care Financing Administration to CMS on June 14, 2001), began a three-year pilot program called the Medicare Acute Care Episode (ACE) Demonstration [12]. Closer in concept to a contemporary bundled payment model, the essential difference between ACE and DRG payments was the inclusion of physician payments, along with hospital payments, for the entire inpatient hospital episode.

Currently, CMS provides universal health care coverage to the growing population of patients over age 65 and is the single largest purchaser of health care services in the United States. With the passage of the ACA and the launch of the CMMI, recent years have witnessed heightened interest in bundled payment models as an alternative to an FFS payment system. Currently, CMMI lists over 40 alternative payment models being implemented for various disease groups, patient populations, and care episodes. Given the growing body of evidence that demonstrates effective cost reduction and quality improvement associated with many of these programs, future years are likely to see an expansion of these programs, regardless of the political climate. In this chapter, we explore the APMs that are most applicable to the practice of TJA, offer suggestions for the successful implementation of these payment models, and review the current evidence gleaned from institutions that have participated in each of these models.

Understanding the Common Alternative Payment Models (APMs)

Bundled Payment Models: Bundled Payments for Care Improvement (BPCI) and Comprehensive Care for Joint Replacement (CJR)

Porter argues that the five conditions for a bundled payment model to maximize value for a patient include the following: (1) the payment should cover the overall care required to treat a condition, (2) payment is contingent on delivering good

outcomes, (3) payment is adjusted for risk, (4) payment provides a fair profit for effective and efficient care, and (5) providers are not responsible for unrelated care or catastrophic cases [4]. These criteria provide a conceptual framework from which to evaluate the merits of any individual bundled payment system and a useful background for an examination of each CMMIC alternative model. As we shall see, while each model may incorporate individual elements of this list, a comprehensive model that maximizes value has yet to be deployed. While a number of alternative payment models have come and gone in recent years, it is useful to examine the narrative of each to provide context for the evaluation of new models as they are proposed.

Originally a 3-year pilot program authorized through the ACA, the Bundled Payments for Care Improvement (BPCI) initiative was introduced by CMMI in 2011; it began accepting applications late during that year and the following year; and the first cohort of awardees in Model 1 began in April of 2013 [13]. Forty-eight different episodes of care, ranging from diabetes care to pacemaker placement, were eligible for participation in BPCI. The eligible episodes defined by the BPCI program pertaining to lower extremity arthroplasty were major joint replacement of the lower extremity (DRG 469 or 470), bilateral simultaneous joint replacement of the lower extremity (DRG 461 or 462), revision of the hip or knee (DRG 466, 467, or 468), and other knee procedures (DRG 485, 486, 487, 488, or 489). While rare instances of participation for many of these episodes have been described, the vast majority of applications of this program were related to uncomplicated primary total hip arthroplasty (THA) and total knee arthroplasty (TKA) (DRG 469 or 470).

Participation in the BPCI program was voluntary, and providers were able to select from four program reimbursement models. Models 1, 2, and 3 were retrospective payment models (payments from CMS occurred after care was delivered), while Model 4 was prospective (payment from CMS was given prior to care given). Model 1 separated physician payments from hospital payments for the global period, while Models 2 and 3 stipulated a retrospective bundled payment where actual expenditures were reconciled against a target price for an episode of care. Whereas both Models 2 and 3 were triggered by an acute care hospitalization, Model 2 included inpatient hospital stay and a 90-day postoperative period. Model 3 only included 90-day postoperative period, beginning with an initiation of postacute care services through a skilled nursing facility (SNF), inpatient rehabilitation facility, long-term care hospital, or home health agency. Under this system, the same payments were made as would be done under an FFS system; however on a quarterly basis, the total expenditures for the episode were compared to the predetermined bundled payment amount (also known as the target price). If the episode cost (reflected by the FFS reimbursement) exceeded the target price, CMS required additional payments; however if costs were less than the target price, Medicare issued a payment to cover the difference.

BPCI was implemented in two separate phases: phase 1 (known as the “preparation” period) and phase 2 (known as the “risk-bearing” period). The entity that was ultimately responsible for bearing the financial risk is known as the BPCI Episode Initiator and could be an acute care hospital, physician group practice, home health

agency, skilled nursing facility, inpatient rehabilitation facility, or a long-term care hospital. In the preparation period, CMS provided the episode initiator with its own historical Medicare expenses to prepare for transition to a bundled reimbursement. Following this data collection period, the CMS, in conjunction with the initiating organization, set quality measures, along with target prices aimed at improvement in costs for a given episode of care. A major contention regarding this method was the tendency for high-cost outlier organizations to participate, given that bonuses were largely based on improvements over past performances, as well as the ability for institutions to choose their own quality measures [5]. For higher performing, already lower cost providers, participation in BPCI was relatively unattractive, given the minimal opportunity for cost savings and bonus payments. Other concerns regarding BPCI included the possibility of withholding care to certain high-risk groups (so-called cherry picking) [14], transfer of high-risk patients to tertiary care centers (so-called lemon dropping) [9], and the inclusion of hip fractures, associated with higher risks and costs, under the definition of the BPCI episode of care [15, 16].

Given these concerns, and building on the previous success of BPCI, in April 2016, the CMS introduced a separate bundled payment model called the Comprehensive Care for Joint Replacement (CJR) [17]. While related, there exist a number of major differences between BPCI and CJR: (1) participation in CJR is mandatory (as of the time of preparation of this chapter, over 400 hospitals in 67 different metropolitan areas are participating in CJR); (2) the duration of participation is 5 years (CJR is currently scheduled to run through December 31, 2020); (3) the model only applies to total hip and total knee replacement (DRG 469 and 470, with a separate hip fracture pathway); (4) the initiator can only be an acute care hospital; (5) target prices are determined from both provider data and regional information; and (6) the discount to CMS is based upon patient quality metrics [9, 17]. These quality metrics used for the calculation of the CMS discount represent a composite score of risk-adjusted complication rates and postdischarge Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) questionnaires.

MACRA and QPP

In parallel with CMMI's development and evaluation of alternative payment models, CMS has spent considerable effort toward containing US health care expenditures and preserving a balanced budget [18]. With the 1997 Balanced Budget Act, Congress passed an amendment to the Social Security Act creating the sustainable growth rate (SGR) formula [19]. The fundamental concept of the SGR effectively tied the growth of US health care expenses to the US gross domestic product. On an annual basis, the formula required an adjustment of FFS payments to maintain budget neutrality. It was not until the first negative adjustment took place in 2002 that physicians took note of this annual ritual [20]. From that point forward, concerned physicians repeatedly awaited Congress' decision as to whether or not a temporary fix would be provided to avoid reductions in reimbursements.

The Medicare Access and CHIP Reauthorization Act of 2015 effectively repealed the SGR and in its place established the Quality Payment Program (QPP), a new system for maintaining budget neutrality, allowing providers to participate through one of two options: the Merit-Based Incentive Payment System (MIPS) and advanced alternative payment methods (APMSs) [18]. QPP, which currently applies to all physicians caring for more than 200 Medicare beneficiaries, billing more than $90,000 a year in charges, and not new to the Medicare system, aims to achieve budget neutrality by providing bonus payments for high-quality care while reducing payments to clinicians who fail to meet value-based standards. It is important to note that this system only achieves budget neutrality if the payment increases to high-performing providers are offset by losses to other providers. While losses in this system are typically fixed, gains will be combined with a "budget neutrality factor" that accounts for the expected inequality between penalized vs. rewarded providers [21]. While a full discussion of MIPS is beyond the scope of this chapter, it is critical to recognize that unless a provider who is eligible for QPP participates in an advanced APM, they will automatically be defaulted to MIPS.

The advanced APM track of the QPP presents providers with the opportunity to earn a 5-percent lump sum incentive payment (on top of Medicare fee schedules) for up to 6 years (2019–2024) [21]. The availability of advanced APMs to current TJA surgeons is limited. To qualify as an advanced APM, the APM must meet three criteria: (1) it requires a minimum of 75% of participants to use certified electronic health record (EHR) technology, (2) it provides payment for covered professional services based on quality measures comparable to those used in MIPS quality performance category, and (3) it either is a medical home model expanded under CMS innovation authority or requires participants to bear a significant financial risk. A minimum of 50% of Medicare Part B payments or at least 35% of Medicare patients must come from an advanced APM. Most advanced APM entities are Accountable Care Organizations [22].

Private Insurance and Employer-Provider Contracts

The most common bundled payment programs are currently being deployed by CMS for application to Medicare beneficiaries. However, the bundled payment model may be applied by any third-party payer, including private insurance companies or large corporations seeking to reduce health care expenses [23]. In 2010, the Agency for Healthcare Research and Quality (AHRQ) awarded a $2.9-million research grant to the Integrated Healthcare Association (IHA), a leadership group, and the Rand Corporation, an independent program evaluator, to create an orthopedic surgery bundled episode model for patients under age 65 in the state of California [24]. The program, called the IHA Bundled Episode and Gainsharing Demonstration, met with similar challenges faced by prior bundled payment initiatives. Despite beginning the program with eight participating hospitals and six health plans, only three health plans ultimately offered contracts and only two hospitals signed these

contracts. In their review of the program, Ridgely and colleagues cite numerous roadblocks to implementing the program, including difficulty in defining the care episode, provider propensity toward offering care to lower risk patients, delays in regulatory mechanisms, and deficiencies in appropriate structures for claims. The authors encourage continued efforts toward the implementation of the bundled payment model in the private sector through simple bundle definitions, the implementation of appropriate use criteria, and developing risk management methods acceptable to all parties.

In addition to bundled payment models initiated by government and commercial insurers, large self-insured employers are more frequently seeking bundled contracts with provider groups when their third-party administrators do not have interest in pursuing these alternative payment structures [4]. The potential advantages of this approach to employers include reductions in health care expenditures, competitive benefit offerings to their employees, and the improved ability to strictly define offered benefits [25]. Two of the more notable attempts by employers in this domain have come from the Pacific Business Group on Health (PBGH), which represents multiple companies, including Lowe's, Walmart, and others), and the Boeing Corporation. In some of these arrangements, predetermined self-insured bundled payments are made to providers in exchange for concierge-like services, including next-day appointments, expanded shared-decision-making tools, and decreased or completely eliminated co-pays. In January 2014, PBGH formed the Employers Center of Excellence Network (ECEN), which used prospective, DRG-based, and episode-based bundled rates to provide care for employees, including coverage for medical and travel expenses during the defined bundle period. Within 2 years, over 1400 TJA procedures had been performed under the ECEN program, which was ultimately expanded to include spine care and other procedures. Compared to patients undergoing TJA under the FFS model, patients under the ECEN model had lower discharge to skilled nursing facilities (9% vs 0%), reduced 30-day readmission rates (5.9% vs 0.4%), and revision procedures (1.1% vs. 0%). Fifteen percent of patients were deemed too high risk for the procedure under the ECEN program, although 8% of these patients opted to continue with surgical intervention under their conventional benefit package [25].

Cash-Pay Practice

A less commonly employed alternative payment model is the cash-pay TJA practice. Under this model, the third-party payer is removed from the equation entirely and the patient pays the physician's professional fees directly out of pocket. Coverage of hospital fees and postacute care charges under this system is variable and depends largely upon prenegotiated rate and the financial structure of the care delivery team. Under some arrangements, while the physician's professional fees are paid directly, the acute-care episode remains covered by negotiated private insurance rates. In other settings, the patient's out-of-pocket payment covers the entire episode of care,