Hip and Knee Replacement at Yale New Haven Health System

Negotiating a "Triple Win" for Patients, Hospitals, and Surgeons

Jean Rosenthal

Edieal Pinker

Working with hospital system administrators, Dr. Mary O’Connor, the director of the Center for Musculoskeletal Care at Yale School of Medicine and Yale New Haven Hospital, looked to change the way hip and knee replacements (arthroplasty) were done in the Yale New Haven Health System. The team from the System fashioned a plan that coupled reduced vendor costs with quality improvements to provide a "triple win" – benefiting patients, surgeons, and the hospital system. Nonetheless, O’Connor’s plan had encountered resistance from a few surgeons who objected to the consolidated list of vendors at the center of the proposal.

O’Connor had come to Yale from Mayo Clinic in 2015. The Yale New Haven Health System had a thriving orthopaedic surgery practice, providing specialized operating facilities and in-hospital patient care. However, O’Connor noted Yale New Haven Health System paid more for prosthetics than many other hospitals. Indeed, the Health System estimated that over the past five years it paid about $3 million more annually for orthopaedic implants than other comparably sized hospitals [dollar amounts disguised]. In order to bring down costs, O’Connor and System administrators identified two vendors who were willing to reduce prices in exchange for becoming the health system's preferred vendors of hip and knee prosthetics.

The cost savings were important to the Yale New Haven Health System, since it was an early participant in a Medicare pilot program that provided a "bundled payment" for hip and knee replacements. Under the program, if the contracted fixed amount was more than the actual fee-for-service claims, then the hospital system would keep the difference. If the contracted fixed amount was less than the actual fee-for-service claims, then the system would have to cut a check to Medicare to refund the difference. The bundle included the cost of implants.

To share the cost savings with surgeons, Stephen Allegretto, Vice President for Value Innovation and Strategic Analytics at the Yale New Haven Health System, discovered that as long as the hospitals tracked individual patient results and improved on quality metrics, the Medicare program would allow gain-sharing based on individual physician performance. Based on outcomes research, Yale New Haven Health System fashioned a protocol focused on decreasing one of the more frequent complications after these surgeries. Yale New Haven Health System could then share a portion of the savings achieved through implant device standardization and adherence to the clinical protocol with physicians as long as the patient did not experience the complication.
But orthopaedic surgeons had always had free rein to choose the prosthetics they wanted at Yale New Haven Health System. When the Health System proposed to reduce costs by consolidating vendors, a couple of surgeons who were well respected in the hospital and the community expressed significant dissatisfaction about having to give up their preferred vendor. Physician dissatisfaction caused by a feeling of a hospital imposing mandates could have a significant political, cultural, and financial impact on the hospital itself. The fate of the plan rested with the leadership of the Yale New Haven Health System, who had to weigh the benefits of the plan versus the probability of alienating surgeons.

O'Connor Comes to Yale New Haven Hospital

Dr. Mary O'Connor moved to New Haven, Connecticut, in May 2015 to serve as the inaugural director of the Center for Musculoskeletal Care. The new center was formed through the partnership of the Yale School of Medicine (YSM) with Yale New Haven Hospital and provided a resource to the entire Yale New Haven Health System. (See Exhibit 1, Announcement of Center and Hire of Mary O'Connor, M.D.)

O'Connor had achieved success and respect in a field where women were rare. While nearly a third of all physicians were female, only 4.3 percent of orthopaedic surgeons were women. Surgery on bones required physical strength, familiarity with power tools, and the determination to succeed in what was often described as a male ex-jock culture. O'Connor’s success in navigating the culture may have benefitted from her own experience as an athlete. She had been a member of the Yale women’s crew in the first decade that women were admitted as undergraduates, and was selected after graduation for the 1980 Olympic rowing team.

After gaining her M.D. from the Medical College of Pennsylvania, O’Connor went to Mayo Clinic School of Graduate Medical Education in Rochester, MN, where she completed an internship, residency, and fellowship in orthopaedics. After her residency, she remained with the Mayo system, practicing at Mayo Clinic Florida. She became a professor of orthopaedic surgery, published research in high-impact scientific journals, and led studies on a variety of new approaches to arthritic changes.

O’Connor also had administrative experience from her time at Mayo. At Mayo Clinic in Florida, she served as a member of the Executive Operations Team, chair of the department of orthopaedic surgery, program director of the adult reconstructive fellowship, and associate medical director for development. She also served as medical director of the Mayo enterprise-wide Office of Integrity and Compliance. O’Connor developed an appreciation of the pragmatic requirements of delivering medical care, often quoting Sister Generose Gervais dictum - “no money, no mission.”

From Mayo to Yale

The Yale New Haven Health System and Mayo Clinics shared similarities. Both were large, prestigious, multi-hospital systems that in addition to serving patients also had significant commitments to teaching and research. However, the governance of the organizations differed markedly. Physicians at Mayo worked in an integrated practice. They received a fixed salary and took the lead in the administration of the system, working closely with other staff to determine all aspects of health care delivery, including clinic and hospital costs.

In contrast, the Yale New Haven Health System relied on a number of inter-related organizations and professional groups with different goals and incentives. In some cases, the associations stretched back over a century. Nonetheless, the groups maintained their individual identities and balance sheets:

- **Yale School of Medicine** had grown in size and prestige over more than 200 years since its founding in 1810. Its 11,000 faculty and staff members included more than 800 clinically active
physicians. In 2014, the school had 527 students in MD programs, with 1,223 graduate students overall. Yale’s educational philosophy emphasized critical thinking and original research. By the 21st century, the school consisted of 28 academic departments, 10 in basic sciences and 18 in clinical, and it was ranked as a top education and research institution.7

- **Yale New Haven Hospital** was a private, nonprofit teaching hospital with 1,541 beds and 11,000 employees. The hospital was the largest acute care provider in southern Connecticut and one of the Northeast’s major referral centers. It had two main campuses and a number of specialized and satellite facilities and hospitals, including a cancer center, a children’s hospital, and a psychiatric hospital. In all, the hospital offered over 100 specialties, with many ranked among the best according to *U.S. News and World Reports*. Since the hospital’s founding in 1826, it had been affiliated with Yale.8 In addition to the 1,400 clinicians from the School of Medicine, Yale New Haven Hospital was used by 3,400 community doctors. Its operating expenses annually were $2.2 billion, with an average daily census of 1,173 and over a million outpatient visits annually.9

- **Yale New Haven Health System** was a network of hospitals and a physician group formed in 1995. In addition to Yale New Haven Hospital, the network consisted of Bridgeport Hospital, Greenwich Hospital, Lawrence + Memorial Hospital in New London, all in Connecticut, and Westerly Hospital in Westerly, Rhode Island. The system also included a physician foundation, Northeast Medical Group, with 70 physician practices throughout two Connecticut counties and New York’s Westchester County. The network maintained clinical relationships with several other hospitals in Connecticut and numerous outpatient locations throughout the state.10 (See Exhibit 2, Major Hospitals in Yale New Haven Health System.)

- **Yale Medicine**, known as the Yale Medical Group until 2016, was the clinical practice of the physicians on the faculty of the Yale School of Medicine. Yale Medicine was one of the country’s largest academic group practices. It provided primary and specialty care with over 220 clinical services in 27 towns throughout Connecticut. The practice was tightly integrated with the Medical School. The CEO, Paul Taheri, MD, MBA, was a Deputy Dean at the School of Medicine. The Chief Medical Officer, Ronald J. Vender, MD, was a professor and associate dean for clinical affairs at the Medical School.11

- **Community physicians** were the independent doctors in Connecticut that admitted patients to the hospitals in the Yale New Haven Health System but were independent of the Yale Medicine. Most hip and knee replacement surgery in the Health System was performed by community physicians. Over the whole system, 70 percent of the volume of orthopaedic surgery was performed by community physicians.

Fixing Hips and Knees

Lower extremity arthroplasty, hip and knee replacements, were most generally performed to ease the severe pain and stiffness resulting from osteoarthritis, the wearing away of the cartilage that separated bony surfaces within the hip or knee joint. The problem was widespread. A third of people between 40 and 64 suffered from hip or knee pain, and over two-thirds of people over 65 were afflicted. There were non-operative medical approaches to help control the problem – pain management, strengthening exercises, and weight loss – but their effectiveness was limited in patients with more severe arthritis. The joint damage was progressive, and there was no cure. For many, replacing the joint became the only option to improve mobility and lessen pain.
The ubiquity of the procedure made hip and knee replacement the most common inpatient surgery under Medicare, the U.S. health insurance for those over 65. Medicare funded more than 400,000 hip and knee replacements in 2014, with a cost of $7 billion for hospitalization alone. The mean Medicare hospital payment for hip or knee replacements was around $30,500, with significant geographic variation. (The most expensive surgeries were in New York, New York, where a knee replacement cost $61,266, while the cheapest average was in Montgomery, Alabama, at $16,097.)

The Procedure

Hip and knee replacement surgery typically took about two hours. During the procedure, a small amount of the damaged surface of each bone was removed and metal and plastic prostheses were implanted using bone cement to attach the components to each bone. The surgery then created new surfaces to cushion the interaction and eliminate bone-on-bone friction in joint movement. By 2016, physicians were pioneering new, less-invasive surgical approaches that accomplished the same objectives.

There were 24 manufacturers producing prostheses for total hip replacements and 31 for total knee replacements. Each manufacturer's line of devices had unique design properties, but there were no clinical studies that showed a clinical difference in the success rate of different devices.

Medicare patients on average stayed in the hospital for three days after surgery, to receive physical therapy, take advantage of special pain relief techniques, and to be monitored for infections and response to medications preventing blood clots. After leaving the hospital, 40 percent of Medicare patients nationwide spent time in a skilled nursing rehabilitation facility, particularly if they were frail, lived alone, or resided in a dwelling with stairs. A patient could expect to use a walker for about two weeks, a cane another four weeks, and continue physical therapy for about three months. (See Exhibit 3, Examples of Hip and Knee Components.)

Success over the long term was a function of the skill and experience of the surgeon and patient compliance with postoperative physical therapy. Complications from the surgery were uncommon and ranged from life threatening to annoying. Complications following the surgery could include:

- Infection, either immediately following the surgery or years later;
- Blood clots, deep venous thrombosis (DVT), which are often symptom-free but can lead to life-threatening situations if portions of the blood clot break off and move to the lungs;
- Ongoing stiffness in the joint.

There were specific medical recommendations to reduce these risks – blood thinners for a short time after surgery to reduce the likelihood of clots, prescriptions for antibiotics whenever the patient undertook any invasive procedure (e.g., dental work), and early mobilization of the new joint.

After surgery, patients were encouraged to avoid high-stress activities like running, but were encouraged to exercise after receiving the new hip or knee – to walk, swim, bike. The implants generally lasted 10 to 15 years before problems could arise, such as wearing out of the plastic insert with loosening of the implants from the bone. Considered as two of the most successful surgical interventions, hip and knee replacement surgeries typically substantially improved the quality of life for patients by significantly decreasing pain and increasing mobility.

Medicare’s Bundled Payment Experiment

With increased pressure to reduce costs and improve quality of care, Medicare was exploring alternative pricing methods. One target was lower extremity surgeries. Hip and knee replacements had become two
of the most common in-patient surgeries performed in Medicare beneficiaries. In October 2013, Medicare initiated an 18-month test of an alternative payment system, the Bundled Payments for Care Improvement (BPCI) Initiative, and these procedures became an early focus of the bundled payment initiative. Traditionally, Medicare reimbursed all providers on a fee-for-service basis for each service provided to a patient and then billed by the provider to Medicare. Medicare did not link any of these services together for any type of specific patient population.

This fee-for-service based payment system created several challenges. The system could result in fragmented care, with minimal coordination across providers and health care settings. In addition, the existing payment system compensated providers for the quantity of services, rather than the quality of care furnished.

The Affordable Care Act created an Innovation Center, to "test innovative payment and service delivery models that have the potential to reduce … expenditures while preserving or enhancing the quality of care for beneficiaries." Based on research that showed that bundled payments could align incentives for providers, the Innovation Center created several models for bundled payments. Generally, one payment level was set for a particular diagnosis and treatment, encompassing service providers, including hospitals, post-acute care providers, physicians, and other practitioners. Medicare would continue to pay each provider of services in the defined patient bundle their fee-for-service payment, but the total actual payments provided for the inpatient anchor stay and the next 90 days would be compared to the target amount and the resulting "gain" or "loss" would be the responsibility of the organization contracting with Medicare for the bundle. The Innovation Center would then evaluate the results of the experiments and recommend new policies in the future.

Participation in the BPCI was voluntary and required participating hospitals to track billed claims per patient for the surgeries, hospital claims, and post-acute care for 90 days after the surgery. Physicians and aftercare facilities continued to receive Medicare's fee-for-service payments; but in the words of the regulations, "total episode payments were reconciled against a target price based on discounted, historical payments. When episode payments were below the target, participants were eligible for additional amounts; when payments were above the target, participants may have had to repay." (See Exhibit 4, An Individual Patient Hospital Profit and Loss Calculation.)

Yale Signs Up for the BPCI

Yale New Haven Health System met the requirements to participate in new Medicare’s bundled service experiment for hip and knee replacements and joined the BPCI in April 2014. (The initiative covered all fee-for-service claims including the surgeons or anesthesiologists, who continued to bill Medicare separately.) To participate in the initiative, Yale New Haven Health System had to take advantage of multiple data platforms the Yale New Haven Health System had installed to track costs and outcomes:

- **Epic electronic health record**, a comprehensive Electronic Health Record system purchased by the Yale New Haven Health System. Installation began at the end of 2010 with an estimated cost of $250 million for five years building and maintaining the system.

- **Clarity database**, a Microsoft SQL server database, linked to the Epic system. Clarity’s database, using a subset of the Epic data, allowed the hospital system to run complex data-intensive research and reports without interfering with the working system.

- **Strata Decision Technology**, a cloud-based system that integrated with these systems to develop reports on QVIS™ (Quality Variation Indicators) as specified by clinical and financial leaders at
Yale New Haven Health System. A QVI might represent a medical complication, or it could also capture an event when recommended plans were not followed, even if there was no negative result for that specific patient.

These systems allowed the hospitals to link clinical, financial, and operational improvements, which in turn allowed administrators to track costs and profit and loss figures per patient and per doctor, as well as quantify the financial impact to the hospital of QVIs.19

The Triple Win Plan

Participating in the BPCI for hip and knee replacements, O’Connor considered ways that Yale New Haven Health System could use the new payment structure to reduce costs and improve quality. O’Connor and the hospital staff realized early on that they could achieve a large cost saving by reducing the number of prostheses vendors and then negotiating for better prices with a consolidated group of vendors. In discussion with Allegretto, O’Connor asked if there was a mechanism to share specific cost savings of implants with surgeons, without a focus on the entire bundle. Allegretto responded that the BPCI program included waivers of certain Medicare regulations otherwise restricting financial relationships between hospitals and physicians that would allow the hospital to share such internal hospital-based savings with individual surgeons if a treatment protocol was followed and certain clinical outcomes were achieved. Under the BPCI, these programs were referred to as Internal Cost Savings Programs. The two-pronged plan of vendor consolidation and treatment protocols would result in a triple benefit – for the hospital, the patients, and the physicians. O’Connor termed this the "triple win."

While elegant in its simplicity, assembling the plan took time and effort. In the end, it took over 30 individuals representing 21 staff areas, with major input from multiple financial reporting and analytics groups, as well as care management, quality improvement, and pharmacy to assemble the plan. (See Exhibit 5, Yale New Haven Health System Staff Working on BPCI at Any Level.)

Vendor Consolidation

Even before she arrived at Yale, O’Connor had talked with the hospital system’s supply chain staff about costs for orthopaedic devices and the negotiation process with vendors. She knew that Yale New Haven Health System’s prices for prostheses used in hip and knee replacement were much higher than those she had observed in the past. With the bundled payment plan, reducing costs represented an opportunity. As Allegretto observed:

> For five years we knew that we had around a $3 million opportunity of standardization.20 We just needed a clinical leader who valued the patient first and then could deal with the dynamics and politics of orthopaedic surgeons.

Negotiating with the vendors would be difficult, but convincing the surgeons to change their preferred prosthetic might be an even bigger challenge. O’Connor’s experience at Mayo had made her aware of the potential complexities. For example, when she was negotiating for Mayo’s Florida clinic, it had proved more nimble in vendor consolidation than had the Rochester facilities, which at times raised tensions.

When O’Connor arrived, Yale New Haven Health System used eight providers for hip and knee prosthetics. The surgeons specified which device they wanted to use, but the hospital purchased and was reimbursed for the device itself. Those surgeons performing fifty or more procedures annually used six manufacturers. (See Exhibit 6, Providers of Prosthetic Devices for Hip and Knee Replacements.)
To begin the vendor negotiations, the supply chain group of Yale New Haven Health System sent out an RFP to all current vendors. The RFP offered prosthesis manufacturers an option that if they agreed to a specified target benchmark price, the hospitals would continue to purchase devices from them. Meeting the benchmark would require the vendors to take around a 15 to 18 percent price cut. The hospital staff estimated that the proposed solution would have an estimated savings of around $3 million of the $16 million total spend under the contract. It would be the least disruptive to surgeons, since none would have to select a new device.

The hospital negotiators were not surprised when no major vendors signed on to the non-restricted vendor option. That refusal then opened the way for a second round of negotiation. Yale New Haven Health System proposed selecting two preferred vendors for 90 percent of their device purchases. (The Health System reserved the right to make 10 percent of purchases from vendors other than the two preferred ones, with exceptions determined at the discretion of the clinical leadership based on demonstrated clinical need. The experiment covered implants for initial or primary joint replacement surgeries. Re-do or revision joint replacement surgeries were excluded, as those might require more complex and varied implants.)

The two-vendor solution would give the hospital savings of at least $2.4 million annually, but implementing this option would require some surgeons to change implant choices. Before offering this option to vendors, the team had begun discussions with surgeons. They knew that the top two vendors already had 36 percent and 32 percent respectively of the hospital's purchases for surgeons performing more than 50 procedures annually. For their part, the top two vendors agreed to the new, lower prices proposed by Yale New Haven Health System.

Convincing Surgeons

Convincing the 60 surgeons who used the Yale New Haven Health System in 2015 for over 2,500 hip and knee procedures to go along with the two-vendor option posed a particular challenge. None of the surgeons had any financial relationships or financial incentives in place with any particular vendor, but surgeons had experience with particular devices and developed close working relationships with the vendors. Vendor representatives did not participate in the surgery, but were in the operating room during every procedure to provide technical support. O'Connor described a typical conversation with surgeons who were concerned about the consolidation:

The most common pushback I would get from surgeons was, "The implant I’m using is better." This is where Steve [Allegretto], even though he would have this knowledge, wouldn’t be able to deliver the message in the same way I could. My response would be, "Show me the data." I know there’s no published clinical data that says that this implant has a superior clinical outcome compared to this other implant. Everybody knows it, but nobody wants to say it. There is no clinical difference in outcome. Now that’s off the table.

But there is validity to surgeons being comfortable with the system that they’re using. There are nuances in the instrumentation and in the implants from one company to another. No question. So I would ask surgeons, "Please help me understand. Have you only used one implant system your entire career?" To which I know the response is "no" for the vast majority, if not all, of the surgeons.

Even surgeons who have used one company for all their careers have changed when the company introduced new products, either a redesign of an existing implant or new instrumentation. In my own career I’ve used three major vendors. I’ve switched depending on our contracts, I’ve switched
depending on reps [the service representative from the implant company who provides technical knowledge of the implant system during the surgery], I’ve switched depending on design changes in implants. I mean there are a myriad of reasons for why you would change. And there is discomfort in change, because the instrumentation is a little bit different. I get that. But I knew that probably every surgeon here has changed use of an implant at some point in his or her career. The difference is if you chose the change, you don’t see it as a change, whereas if someone else is imposing the change on you, then you see it as a change.

Internal Cost Savings under Medicare

The vendor program could play an important role in helping the Yale New Haven Hospital System. The Bundled Payment Care Improvement (BPCI) program, which the System had joined, allowed providers contracting with Medicare to accept the financial risk of providing "a set of services" for a fixed amount. This amount covered the services a patient received in the hospital, for the "anchor admission" and the following 90 days. This contracted fixed amount would then be compared to the actual fee-for-service claims paid by Medicare to all of the providers who provided services to the patient during that 90-day period. If the contracted fixed amount was more than the actual fee-for-service claims, then the hospital system would keep the difference. If the contracted fixed amount was less than the actual fee for service claims, then the hospital system would have to cut a check to Medicare to refund the difference. In this way, a system took the risk of overall claims paid being higher than the target benchmark, but it could keep the savings if it could deliver the "set of services" at a lower price.

The set of services included all the services provided by the hospital, the surgeon, skilled nursing facilities, and home health agencies. And the traditional fee-for-service payment that the hospital system received for the "anchor admission" was intended to not only cover the cost of the inpatient stay but also the cost of the implant used by the surgeon.

Prior to the BPCI bundle program, hospitals were not allowed to share any type of hospital-based savings with the surgeon. With BPCI, hospitals did have some options for sharing cost savings.

The most common mechanism for shared savings was to participate in the cost reductions of the total bundle, i.e., the hospital admission and 90 days of care thereafter. For the Yale New Haven Health System program, the savings would be for the performance of the total bundle across the entire health system, including the three major hospitals, Yale New Haven, Bridgeport, and Greenwich. As post-hospital discharge costs related to skilled nursing facilities (SNF) would dominate the bundle, surgeons who discharged more patients to a skilled nursing facility would generate no savings or lower savings to the total bundle than those who discharged patients to home. Thus, the ability for an individual surgeon to share in bundle savings could be influenced by the performance of all surgeons across the system.

However, in this method of gain-sharing, the financial incentives did not align the hospital and the surgeon’s switch of implant vendors. Implant cost savings were internal hospital cost savings and not at all related to Medicare fee-for-service claim payments. Allegretto knew another way that could coordinate the System and an individual surgeon. He explained:

I know a lot of folks don’t like the ACA [Affordable Care Act], but there are a couple of nice things in there about bundles, and there’s this little-known section of BPCI called the Internal Cost Savings (ICS). It says that if you have a cost accounting system where you can track individual patients and individual surgeons, and you’re able to show a quality and a cost improvement on the patient level, you can share some of those internal savings with surgeons.
Indeed, Allegretto had been championing using the ICS program even before O’Connor had arrived at Yale New Haven Health System, but noted, "I just couldn’t get anybody that wanted to lead that effort."

Under the terms of the ICS program, the amount of hospital savings that the system could share with surgeons was limited to a per-patient cap of an additional 50 percent of the fee Medicare paid the surgeon to perform the hip or knee replacement and care for the patient for the first 90 days after hospital discharge. For determining the level of physician gain-sharing utilizing the ICS option within the BPCI bundle, Yale New Haven Health System chose an option that compared hospital costs and billed amounts for an individual patient’s initial surgery and hospital stay, termed the anchor or index hospital admission. This allowed a focus on costs under the hospital’s control, as well as a more timely calculation. However, it did create an additional risk for the hospital system: the calculation based on the anchor costs could lead to savings eligible for gain-sharing, but billings incurred after the initial hospital stay might turn the 90-day BPCI calculation into a loss, which the hospital system would have to absorb. (See Exhibit 7, Comparison of Bundled Payments Versus Internal Cost Savings.)

The ICS gain-share calculation for physicians required proof of both hospital savings AND improvement in quality metrics related to procedures on an individual patient level. Procedures covered by private insurance were not eligible for gain-sharing with physicians, but most of the hip and knee replacements (and two-thirds of Yale New Haven Hospital’s billings overall) were covered by government insurance – Medicare and Medicaid. (See Exhibit 8, Schematic of Orthopedic Bundle.)

An effort to improve post-operative outcomes for hip and knee replacement surgery had already been underway. Yale New Haven Health System knew that its rate of occurrence for blood clots, technically known as venous thromboembolism (VTE) including deep venous thrombosis (DVT), and pulmonary embolism (PE) following hip and knee replacement, was higher than national benchmarks. The system’s "charter committee" (a group that brought in clinical and non-clinical staff to address improvements in specific areas of concern related to safety and quality) was already developing a protocol to attack this problem. O’Connor was added to this charter committee and a protocol was finalized for hip and knee replacement patients. The new protocol was flexible for ease of adoption and standardized the definition for high-risk patients. After a patient was assessed for level of risk, the quality metrics for compliance looked at four activities:

1. Use of the order set
2. Correct medication order as indicated by risk stratification
3. Administration of the first dose within 24 hours of anesthesia end time
4. Use of mechanical prophylaxis [devices that provided compression to improve blood flow]

The Medicare Internal Cost Saving option provided additional impetus for quickly implementing this new protocol across the system. Allegretto knew that the Centers for Medicare & Medicaid Services (CMS), the government agency charged with administering federal healthcare programs, was creating a new hip and knee replacement bundle, the CJR program, which would be mandatory for many geographic regions in the country. By choosing to participate in the BPCI program, Yale New Haven Health System would be able to continue in the voluntary program for an additional 20 months; it was unclear what the bundle program would be for the system thereafter. Because, the opportunity for sharing savings with the surgeons in the internal cost saving portion of the BPCI bundle was, by its nature, time-limited. Allegretto and O’Connor based their calculations assuming that the shared saving with the surgeons would extend for 8 months under the existing program.
The protocol established a quality outcome that could be measured for each patient and surgeon, rather than looking only at the system-wide occurrence of infrequent complications. The preferred options and risk assessments were built into the Epic system, to facilitate clinical use. (See Exhibit 9, Images from Implementation in the Epic System.)

When the protocols were followed and no thrombosis occurred during the hospital stay, then surgeons could share some of the savings attributable to the treatment of the patient. The level of the physician’s gain-sharing revenue was based on each surgeon's individual baseline implant costs and only applied to patients insured by traditional Medicare. There were no negative incentives for physicians – a feature of the program O’Connor emphasized as critical to patient care.

The calculations were complicated. Given the fraud and abuse waivers granted by CMS under the BPCI program allowing these gain-sharing arrangements, an outside firm reviewed the first round of measurements, and then both the internal audit and compliance departments within the hospital went over the results. The role of internal audit/compliance was to review any potential risk areas throughout the System to ensure compliance with both internal and external requirements. O’Connor and Allegretto met with the internal audit/compliance analysts to discuss their findings, address any questions or concerns they might have about the process, and also hear their suggestions for improvement. By the end of the exercise, the participants were comfortable with the results, made a number of key suggestions on how to improve the process, and felt they had created industry standards for this innovative program.

Presenting to the Yale New Haven Health System Cabinet

The plan needed approval from the Yale New Haven Health System Cabinet before implementation. The cabinet consisted of the top-level leadership group across the system, including Marna P. Borgstrom, the CEO of Yale New Haven Health System and the CEOs of the various delivery networks and the physician group. They had the authority to make system-wide decisions.

The stakes for Yale New Haven Health System were high. Offering hip and knee replacements required specialized facilities at each hospital, with high-fixed-cost operating rooms and specialized equipment. These procedures were elective, rather than urgent responses to accidents or illness, so the hospitals had to make their programs inviting at several levels. Patients chose doctors, and doctors chose hospitals, and both groups were sensitive to the quality of care in the hospital and flexibility that the hospital offered to the orthopaedic surgeons.

O’Connor and Allegretto could report that several stakeholders had bought into the program, even with the limitations on vendors of prosthetics. Paul Taheri, CEO of Yale Medicine, had agreed to support the program, and the Yale Medicine orthopaedic surgeons had agreed to participate.

But not all of the surgeons had been swayed by the arguments and incentives. The system staff knew that at least two orthopaedic surgeons would likely be dissatisfied with the standardization decision, since they primarily used prosthetics that would be eliminated by the vendor consolidation. One orthopaedic surgeon used an eliminated vendor for all his procedures, and the second used an eliminated vendor for about half his procedures. If the hospital system insisted on restricting vendors, one or both could possibly move their patients to other hospitals.

While acknowledging that losing certain surgeons could have immediate revenue effects, O’Connor and Allegretto presented the Cabinet with the risk of not implementing the program. If the hospital system did not implement the vendor standardization, it would make it more difficult to meet the cost metrics for Medicare’s Orthopaedic Bundle experiment, and it would leave Yale New Haven Health System on the
hook for the costs over benchmark. Also, if Yale New Haven Health System did not meet the cost benchmark through vendor standardization, they would also lose the ability to share savings with surgeons under the ICS program.

Allegretto had hopes for additional future benefits. He believed that vendor consolidation in this area would serve as a model – or a warning – for other providers in the supply chain, to let them know that the hospital was serious about cost reductions. Negotiations were coming up for spine and shoulder implant devices, with the same vendors. If the hospital system could not push through the consolidated vendor option, it would lose its leverage in these subsequent negotiations.

Part of the challenge to the Cabinet’s decision making was that the system had never done anything like this. And as O’Connor noted, limiting vendors and possibly losing surgeons required the Cabinet to take a big risk.

These were complicated decisions, which had many real and potential consequences to disrupt established relationships that governed clinical care and operational workflows among clinicians, patients, staff, vendors, and the Yale New Haven Health System. The Health System’s commitment and pursuit of changes to improve value for its patients came with a risk of unhappy surgeons, who might seek other facilities that did not limit their choices with respect to certain medical devices.

Endnotes

1 Project Editor, Case Study Research and Development, Yale School of Management
2 Professor of Operations Research, Yale School of Management
3 All numbers disguised for proprietary reasons.
Mayo Clinic physician to lead new Musculoskeletal Center, Yale School of Medicine, Press Release, January 6, 2015.

Sister Generose Gervais was the last Franciscan nun to run Saint Mary’s Hospital in Rochester, Minnesota, before the hospital was integrated into the Mayo system.

https://medicine.yale.edu/about/ and http://medicine.yale.edu/about/history.aspx, accessed December 12, 2016.

The hospital was affiliated with the Medical Institution of Yale College before formal affiliation agreement with the medical school was drawn up in 1917.


http://medicine.yale.edu/ymadmin/about/, accessed December 12, 2016.


All numbers disguised for proprietary reasons.

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Mary I. O’Connor, M.D., has been named the inaugural director of the Musculoskeletal Center at Yale School of Medicine (YSM) and Yale-New Haven Hospital (YNHH), starting in May 2015. Her appointment was announced today by YSM Dean Robert J. Alpern, M.D., and YNHH President Richard D’Aquila.

Similar to the Yale Cancer Center, the Musculoskeletal Center will coordinate interdepartmental clinical and research programs at the medical school and hospital. As a clinical and research center, it brings together specialists in orthopaedics, neurosurgery, neurology, rheumatology, rehabilitation, biomedical engineering, and other specialties to provide a wide range of services, including joint replacement, pain management, and advanced treatment for arthritis, spine disorders, multiple sclerosis, Parkinson disease, and other conditions.

Dr. O’Connor is professor of orthopedic surgery at Mayo Clinic College of Medicine and program director of the adult reconstructive fellowship at Mayo Clinic in Florida. She is the medical director of the Mayo Clinic Integrity and Compliance Office and an associate medical director for the Department of Development. She completed her tenure as chair of the Orthopedic Surgery Department at Mayo Clinic in Florida in early 2014 and served on Mayo’s Florida Executive Operations Team from 2002 to 2013. She earned her B.A. degree in biochemistry from Yale University and her M.D. degree from Medical College of Pennsylvania. She went on to attend Mayo Graduate School of Medicine, where she completed an internship and residency in orthopaedics and fellowship in orthopaedic oncology.

In her practice at Mayo, Dr. O’Connor treats both orthopaedic oncology patients and adults requiring complex reconstructive surgeries for degenerative joint diseases. Her research has been published in high-impact scientific journals. She leads studies focused on joint replacement surgery of the hip and knee, limb salvage surgery for bone and soft tissue tumors, the influence of sex and gender on treatment and outcomes in arthritis, and processes to improve value in the delivery of health care. She is co-investigator on a new pilot study to determine if injecting a patient’s stem cells into his or her knee joint will slow the progression of—or possibly reverse—arthritic changes.

Dr. O’Connor has received numerous awards and honors during her training and career, including being named a Distinguished Clinician at Mayo Clinic and receiving The Corinne Farrell Award from the International Skeletal Society in 2009. She received the Congressional Gold Medal as a 1980 Olympian and is noted for her encouragement of women in career advancement.
Dr. O'Connor has served as president of the Association of Bone and Joint Surgeons, the International Society for Limb Salvage, the American Association of Hip and Knee Surgeons, the Musculoskeletal Tumor Society, and the Ruth Jackson Orthopaedic Society. She is a board member of The Perry Initiative Foundation, a group focused on introducing orthopaedics and engineering to young women. She is a consultant with the Orthopaedic and Rehabilitation Devices Panel for the U.S. Food and Drug Administration Medical Devices Advisory Committee and is a panel member for the Medicare Evidence Development & Coverage Advisory Committee. She also serves as chair of the Diversity Advisory Board of the American Association of Orthopaedic Surgeons and co-chairs the national Movement is Life Caucus, a multi-stakeholder group devoted to decreasing musculoskeletal healthcare disparities.
Exhibit 2: Largest Connecticut Hospitals in the Yale New Haven Health System

<table>
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<tr>
<th>Critical Indicators</th>
<th>Yale-New Haven</th>
<th>Bridgeport</th>
<th>Greenwich</th>
<th>Northeast Medical</th>
<th>TOTAL</th>
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<tr>
<td>Total Licensed Beds**</td>
<td>1,541</td>
<td>383</td>
<td>206</td>
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<td>Inpatient Discharges*</td>
<td>78,529</td>
<td>18,208</td>
<td>12,538</td>
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<td>Outpatient Encounters*</td>
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<td>277,043</td>
<td>289,860</td>
<td>402,000*</td>
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<td>Net Patient Service Revenue*</td>
<td>$2.4B</td>
<td>$439 M</td>
<td>$349 M</td>
<td>$123 M</td>
<td>$3.3B</td>
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<td>Medical Staff****</td>
<td>4,080</td>
<td>1,150</td>
<td>661</td>
<td>668</td>
<td>6,491</td>
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<td>Employees</td>
<td>12,428</td>
<td>2,819</td>
<td>1,636</td>
<td>1,050</td>
<td>20,282****</td>
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Exhibit 3: Examples of Hip and Knee Replacement Components

**Total Hip Replacement**

(Left) The individual components of a total hip replacement. (Center) The components merged into an implant. (Right) The implant as it fits into the hip.

**Total Knee Replacement**

(Left) Severe osteoarthritis. (Right) The arthritic cartilage and underlying bone has been removed and resurfaced with metal implants on the femur and tibia. A plastic spacer has been placed in between the implants. The patellar component is not shown for clarity.

### Exhibit 4: An Individual Patient Hospital Profit and Loss Calculation

#### Financial Performance over Time

In this individual patient record with disguised data, the physician gain-sharing would have been calculated based on costs and revenues in the initial hospital stay, the index or anchor admission (row 2).

The second hospital admission (line 6) added significantly to the 90-day bundle costs (line 11), for which the system would at risk under the Bundled Payments for Care Improvement (BCPI).

Costs incurred more than 90 days from the index admission, including the hospital stay (line 15), would not be part of the bundled pay experiment.

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<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
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<td>2</td>
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<td>$81</td>
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<td>$349</td>
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</table>

**Note:**
Data from one patient. Dollar amounts for educational purposes only and are disguised to protect proprietary information.
Exhibit 5: Yale New Haven Health System Staff (RN, CC, Admin, MD, etc.) Working on BPCI

Areas/Roles Estimating More than 100 Hours Highlighted in Table Below

1. Account/Corporate Finance
2. Accounting
3. Budget
4. Care Management
5. Clinical Support/reporting
6. Contracting
7. Finance/Analytics/Administration
8. Financial reporting
9. Internal Consulting Group - Project Management
10. Internal Compliance
11. Information Technology Services
12. Joint Data Analytics Training (JDAT)
13. Legal
14. Operations/Administration
15. Performance Improvement
16. Pharmacy Lead and support
17. Quality Improvement
18. Service Line/Clinical Lead
19. Supply Chain
20. Supply Chain/Contracting
21. Program Lead

Total annual FTE: 1.28
Total Hours Reported: 2,658

Source, Mary I. O’Connor, MD and Stephen Allegretto, CPA, MPH, Presentation: The Internal Cost Savings Program, Yale New Haven Health System and Yale University.
Exhibit 7: Comparison of Bundled Payments versus Internal Cost Savings

Source, Adapted from Mary I. O’Connor, MD and Stephen Allegretto, CPA, MPH, Presentation: The Internal Cost Savings Program, Yale New Haven Health System and Yale University.
Gain-share payment to a surgeon for a particular patient required meeting several criteria:

- **Cost Metrics**: Beating the index (anchor) hospitalization cost/billing metric
  - Surgeon participation
- **Quality metrics**: meeting the standard and good outcome
  - Compliance with the protocol
  - No blood clot develops
Exhibit 9: Images from Implementation Steps Required in Epic System

1. Enhanced order sets already in use

2. Modified VTE prophylaxis section

3. Created a risk assessment categorization within Epic

4. Required completion of each portion to sign order

[Continued on next page]
Exhibit 9 continued:

5. Built smart groups that had a smart set base restrictor that used criteria (age and BMI) to display the correct pharmacological options based on true risk categorization.