Using Time-Driven Activity-Based Costing to Identify Value Improvement Opportunities in Healthcare

Robert S. Kaplan, PhD, senior fellow and professor, emeritus, Harvard Business School, Boston, Massachusetts; Mary Witkowski, fellow, Harvard Business School, and MD candidate, Harvard Medical School, Cambridge, Massachusetts; Megan Abbott, MD, attending physician, Maine Medical Center, Portland; Alexis Barboza Guzman, project consultant, Institute for Cancer Center Innovation, Houston, Texas; Laurence D. Higgins, MD, chief, sports medicine and shoulder service, Department of Orthopedic Surgery, Brigham and Women's Hospital, Boston; John G. Meara, MD, DMD, director, Program in Global Surgery and Social Change, Harvard Medical School, and plastic surgeon–in-chief, Department of Plastic & Oral Surgery, Boston Children's Hospital; Erin Padden, operations coordinator, sports medicine and shoulder service, Brigham and Women's Hospital; Apurva S. Shah, MD, assistant professor, orthopedic surgery, Department of Orthopaedics and Rehabilitation, University of Iowa Hospitals and Clinics, Iowa City; Peter Waters, MD, John E. Hall professor of orthopedic surgery, Harvard Medical School, and orthopedic surgeon–in-chief, Orthopedic Center, Boston Children's Hospital; Marco Weidemeier, consultant, medical management, Schön Klinik, Prien am Chiemsee, Germany; Sam Wertheimer, senior policy associate, Massachusetts Health Policy Commission, Boston; and Thomas W. Feeley, MD, professor and division head, University of Texas MD Anderson Cancer Center, Houston, Texas

EXECUTIVE SUMMARY

As healthcare providers cope with pricing pressures and increased accountability for performance, they should be rededicating themselves to improving the value they deliver to their patients: better outcomes and lower costs. Time-driven activity-based costing offers the potential for clinicians to redesign their care processes toward that end. This costing approach, however, is new to healthcare and has not yet been systematically implemented and evaluated. This article describes early time-driven activity-based costing work at several leading healthcare organizations in the United States and Europe. It identifies the opportunities they found to improve value for patients and demonstrates how this costing method can serve as the foundation for new bundled payment reimbursement approaches.

For more information about the concepts in this article, contact Dr. Kaplan at rkaplan@hbs.edu.

INTRODUCTION

Healthcare organizations have begun to feel the pricing pressure from payers, such as federal, state, and commercial insurers and self-insured corporations. Payment rates are being capped or reduced and new reimbursement methods introduced just as access is being extended to previously uninsured populations.

In this rapidly changing and increasingly constrained environment, providers that learn how to lower their costs in a sustainable manner while maintaining or improving outcomes can survive and prosper. Their executive leadership must set an objective to increase the value that their organization delivers to patients in the form of improved healthcare outcomes at lower cost (Porter, 2010; Porter, Pabo, & Lee, 2013).

The greatest opportunity for lowering costs without sacrificing quality, safety, or outcomes is gained from helping clinicians intelligently reengineer their clinical and administrative processes (Hoffman & Emanuel, 2013; Berwick, 2012). Some clinicians, however, resist top-down pressure to assume responsibility for cost reductions (Tilburt et al., 2013). Others may recognize that cost considerations should be incorporated into physician treatment decisions and clinical process designs (Brook, 2011) but lack the information or organizational support to institute significant changes. The existing cost systems in healthcare impede clinician-driven cost reduction and process improvement initiatives. These systems rely on inaccurate and arbitrary cost allocations and provide little transparency to guide attempts by first-line care providers to understand and modify the true drivers of their costs (Kaplan & Porter, 2011).

One tool with significant potential to fill this gap is time-driven activity-based costing (TDABC) (Kaplan & Anderson, 2007). Activity-based costing has been widely adopted and used in industries outside of healthcare to improve operational processes and help managers make better decisions about resource allocation, product and service mix, and pricing. But applications of TDABC to healthcare have been limited (Hennrikus, Waters, Bae, Sohrab, & Shah, 2013; French et al., 2012). In this article, we describe how clinicians at several leading healthcare organizations in the United States and Europe have begun to apply TDABC to identify multiple opportunities to improve the value they deliver to patients.

BACKGROUND

TDABC enables providers to measure accurately the costs of treating patients for a specific medical condition across a full longitudinal care cycle. It uses two proven management tools: process mapping from industrial engineering, and activity-based costing from accounting. Clinical teams direct the process-mapping component. They start by identifying the high-level events in a care cycle, and then they drill down into the process steps that occur in each event (see Figures 1 and 2 for process map examples). A process step is a discrete activity involving one or more clinical resources—personnel and/or equipment. Developing process maps enables frontline clinicians to describe all the clinical and administrative

FIGURE 1
Process Mapping

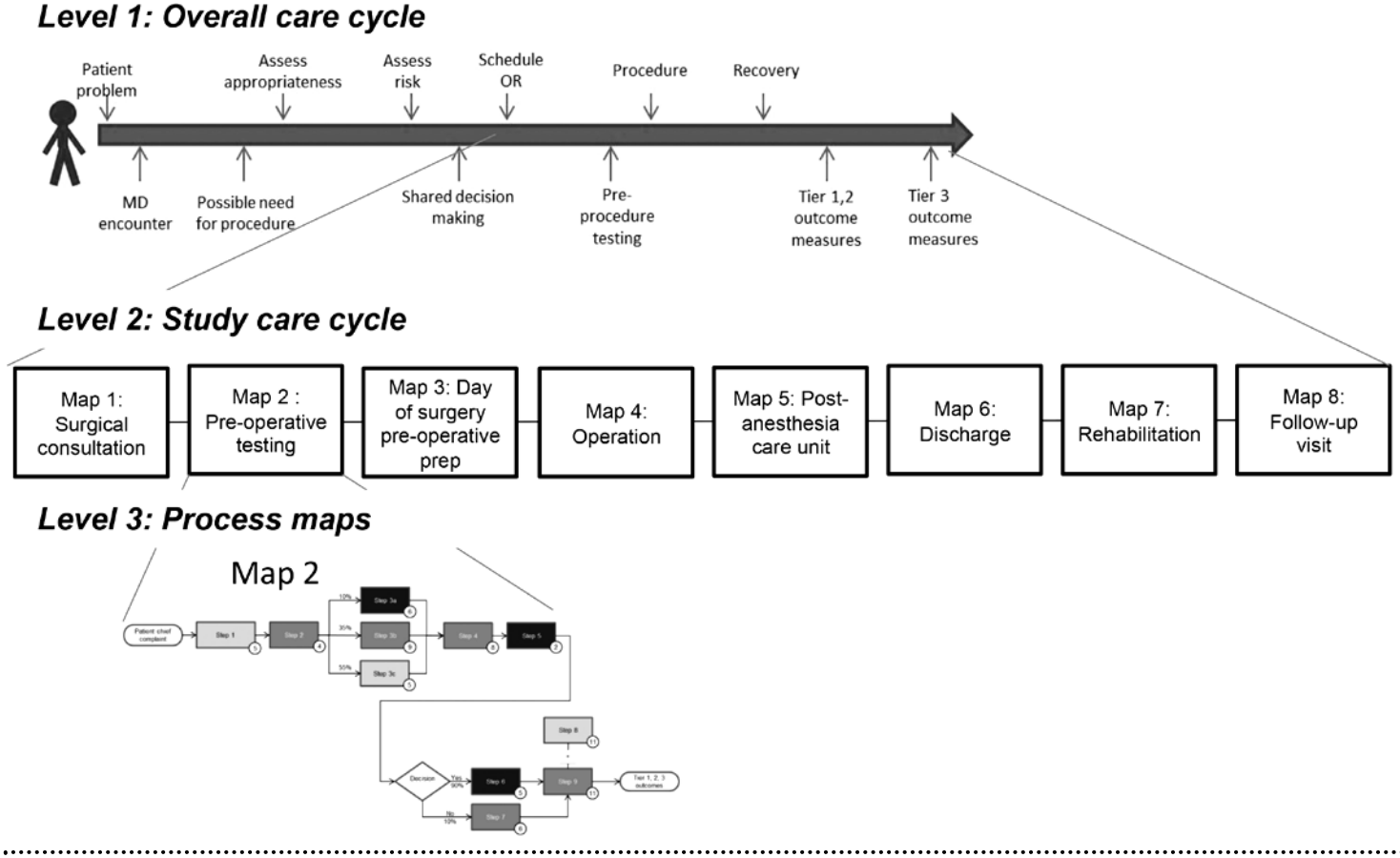
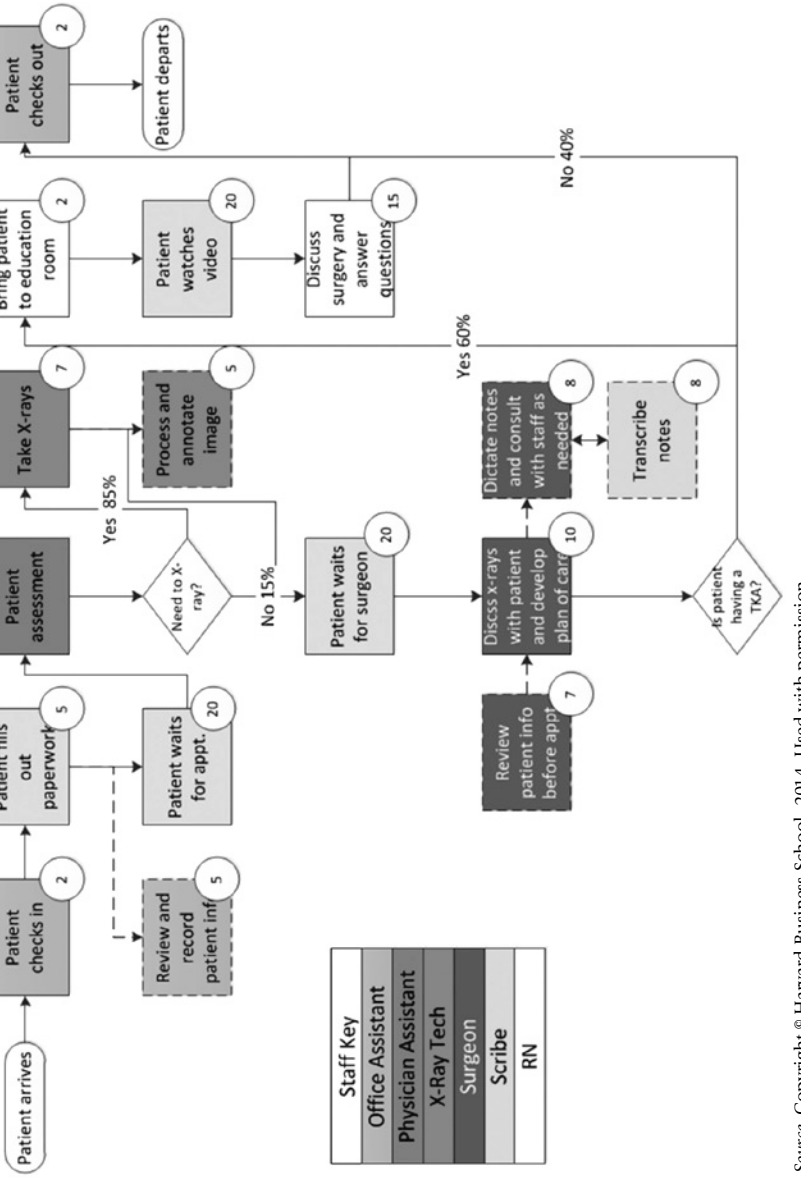


FIGURE 2
Example of a Process Map (initial orthopedic appointment)



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process steps involved in a patient's complete cycle of care, along with the resources and time consumed at that process step.

Parallel to the process mapping, the finance staff develops the cost component by constructing a dollar-per-minute capacity cost rate for each clinical resource involved in the care cycle. The numerator in the capacity cost rate is the total cost the provider organization incurs to make each resource productive and available for the patient. Personnel costs include compensation and the costs of office space, technology, training, supervision, and other indirect expenses incurred to support each staff person. Space and equipment costs include depreciation or rental expense and the costs of the space occupied, utilities, consumable supplies, and maintenance and repairs.

The denominator is the estimated total capacity, measured in hours or minutes during which each resource is available for productive work. Personnel capacity is total clinical time available for work minus the time not available due to vacations, holidays, training, education, research, meetings, and breaks during the day. Space and equipment capacity are total budgeted time available during normal working hours minus maintenance and scheduled downtime.

The dollar-per-minute capacity cost rate is multiplied by the time spent by each resource involved in a process step to measure the cost of the clinical and staff resources used at each process step. The costs of any consumable supplies (medications, syringes, catheters, bandages, implants, etc.) used are added to this amount to obtain the total cost of performing the process step. The TDABC estimate of the total cost of caring for the patient is the sum of all the process step costs over the entire care cycle. The project team incorporates risk adjustments and care variability by including decision nodes that depict alternative care paths to be followed when appropriate for a patient's specific circumstances.

Initially, we focused on personnel and material costs, which comprise the majority of expenses incurred in the clinical units. In principle, the pilot sites have the ability to perform similar analyses—process maps and capacity cost rates of employees, equipment, and space—for ancillary departments, such as imaging, pathology, pharmacy, and central sterilization, and for the provider's indirect and support departments, such as billing, collections, dietary, housekeeping, human resources, finance, and IT. TDABC does enable ancillary and overhead costs to be assigned more accurately, but the pilot sites chose to focus on the larger and more visible direct costs incurred in their patient-facing units.

Near- and Long-Term Value Improvements

Valid costs for patient care provide the common data for clinicians and administrators to collaborate on multiple cost reduction and process improvement projects. They can identify the high costs of certain process steps, discover any process steps that are redundant or that do not contribute to better patient outcomes, and detect the unused capacity of people and equipment. They

can conduct benchmarking studies by comparing treatment variations and outcomes for the same medical condition across clinicians, facilities, and institutions.

Without TDABC, providers cannot readily benchmark the cost of treating a clinical condition at different sites because (a) costs are rarely measured over a complete cycle of clinical care; (b) most costs are allocated arbitrarily and inaccurately to patients, making these costs irrelevant to clinical measurement; and (c) differences in costs due to variations in the prices of inputs (the unit prices paid for drugs, implants, and other consumables; for medical and clinical personnel; and for real estate and equipment) cannot be disentangled from differences due to efficiencies and productivities. Furthermore, existing cost estimates are usually not linked to condition- and site-specific outcomes data, making it impossible to estimate the cost improvements that can be made without reducing the quality of care delivered.

Near-term opportunities for cost reductions include process redesigns that eliminate non-value-added steps, substitution with lower-cost resources when clinically appropriate, increased efficiency of high-cost process steps, and improved capacity utilization of expensive resources (Kaplan & Porter, 2011). Longer-term opportunities include enhancements in matching clinical and administrative resource capacity to the demands for those resources and the development of innovative reimbursement models, such as bundled payments, that link pricing to the delivery of superior outcomes at lower costs.

TESTING TDABC IN HEALTHCARE ORGANIZATIONS

Starting in 2010, an internally funded group at Harvard Business School (HBS) launched an effort to explore the feasibility and potential benefits of applying TDABC in healthcare organizations. The group collaborated with clinical departments in several provider organizations that were treating discrete clinical episodes in either an inpatient or outpatient setting (see Table 1). The departmental leaders wanted to implement and evaluate the TDABC approach in their organizations. They assigned clinical and administrative resources for the projects and shared their process maps, costing data, and qualitative reports on their progress with the HBS group. Most of the project leaders were senior physicians, though some held senior management positions in their organizations.

RESULTS

Identifying Improvement Opportunities

The TDABC team from the Boston Children's Hospital orthopedic department found that a defect in X-ray ordering increased the normal order processing cost from $0.71 to more than $10.00 per order. When an order for a radiograph was unclear (e.g., whether the cast should be removed prior to the X-ray), patients had to wait 15 to 30 minutes for the issue to be resolved by the radiology technician, the radiology front desk clerk, the patient service representative, and the clinical care team. Much like an airline flight delay, the defect rippled through the downstream scheduling of patients for other

TABLE 1
Pilot Sites for TDABC Projects: Summary

Name	Country	Provider type	Ownership type
Schön Klinik	Germany	Specialty orthopedic hospital	Private, for-profit
Boston Children's Hospital	United States	Pediatric hospital	Private, nonprofit
MD Anderson Cancer Center	United States	Cancer center	Public
Brigham and Women's Hospital	United States	General hospital	Private, nonprofit

process steps, leading to longer patient delays and higher costs. In addition to the higher costs, the delays caused by communication errors can lead to patients feeling frustrated, confused, and anxious. The team estimated that redesigning the X-ray process so that orders would clearly and consistently articulate physician preferences would produce both a 94% cost saving for this process step and an increase in patient satisfaction. This team also learned that the average capacity utilization of the room was less than 80% (Shah et al., 2013), which led the group to consider increasing throughput for this clinical resource.

At the Brigham and Women's Hospital orthopedics department, a project team evaluating rotator cuff repair (RCR) used TDABC to identify and set priorities for several cost-saving opportunities. The team first estimated the total cost of an RCR episode of care, defined as the entirety of orthopedic care, starting from the initial surgical consultation and ending with the one-year postoperative follow-up visit. The care cycle included surgical, nursing, recovery, outpatient, physical therapy, billing, and patient coordination processes, as well as all medications. As the team conducted process mapping sessions, it identified numerous process improvement opportunities, such as the lengthy time that patients spent in the high-cost postacute care unit (PACU). Extended PACU stays were more common for patients who had not received a preoperative nerve block and therefore required additional attention from nurses and the administration of painkillers once general anesthesia had worn off. The team determined that it could diminish bottlenecks in the PACU and reduce total costs by delivering a nerve block prior to RCR surgery. This procedural change had both a financial and a clinical benefit. The process map and cost data informed the beneficial decision to shift the patient's time from the expensive PACU to the less expensive preoperative unit, a change that could be accomplished without delaying the start of the operation itself. The shift also improved patient outcomes by reducing postoperative pain and discomfort.

Team meetings among the Brigham and Women's clinical staff identified opportunities for significant efficiency improvements in administrative

processes. Among these were the increased utilization of nonphysician resources during postoperative care and presurgical team meetings, which involved, among other tasks, loading patient images prior to the day of surgery to reduce delays when all the expensive clinicians and staff were assembled in the operating room. The team also developed alternative physical therapy models, including group rather than individual therapy sessions. Historically, the number and length of patient visits to the therapist were determined largely by payers' allowances, not by clinical evidence. The BWH team's recommended changes would reduce postoperative care costs by 25% while achieving the same or better patient outcomes. Over time, having the patients do more of their therapy at home, with therapists monitoring patients' progress and compliance electronically using web-enabled video technology, offered another potential 20% savings.

The project team in Boston Children's Department of Plastic & Oral Surgery studied the protocol for children undergoing cleft palate surgery. They found that children with higher-than-normal airway risk, such as Robin sequence patients, were being placed in the intensive care unit (ICU) during the acute postoperative recovery period. The lead physician (JGM) knew that ICU care was expensive, but he was surprised to learn its magnitude: This process step alone represented up to 28% of total costs for the first 18 months of care. Although ICU monitoring is normal in many U.S. hospitals, the lead physician knew from his experience in Australia that the patients could alternatively be managed in a step-down unit that has the necessary nurse-to-patient staffing ratio and monitoring equipment without the additional infrastructure cost of a fully equipped ICU. Substituting the step-down unit for the ICU for acute postsurgical recovery could save 8% of the total 18-month cost of care.

Reengineering to Improve Value

The Boston Children's orthopedics department instituted a standardized algorithm—referred to as a SCAMP (Standardized Clinical Assessment and Management Plan) (Farias et al., 2013)—for treating all distal radius fractures. The SCAMP's goal was to reduce care variation and overall costs while maintaining safe and optimal outcomes. To speed implementation of the changes, the group focused on improvements that could be effected immediately with minimal disruption to current workflows. Among these improvements were to use an emergency department splint to replace cast treatment and to conduct a telephone follow-up rather than schedule clinic appointments for specific uncomplicated fractures. For more complicated fractures, a review of combined SCAMP and TDABC data led to the elimination of radiographs at certain follow-up appointments, yielding cost savings of 12.4%.

The quick-win changes identified at the Brigham and Women's orthopedics department included replacing the physician's visit with the patient immediately following surgery, when the patient is still affected by anesthesia, with a more effective follow-up call the

TABLE 2
Identified Improvement Opportunities at Brigham and Women's Hospital Orthopedics Department

TDABC Category	Description	Impacted Staff	Cost Savings		Patient Value
			% of Total Care Cycle	% of Step	
Underutilized Resources	Waiting for MD in PACU	Nurses, admin.	2.0%	38%	Positive
	MD phone "tag"	MD	1.0%	17%	Positive
	Cardiac monitor bottleneck	Nurse	0.5%	19%	Neutral
Process Inefficiencies	Preparing OR cases week prior	MD, admin.	4.0%	11%	Neutral
	Mailing forms before appointment	Admin.	0.1%	9%	Positive
Care Delivery Redesign	Combining PACU Phases 1 & 2	Patient, nurse	0.3%	6%	Positive
	Reducing PT visits by 20%	PT, patient	4.0%	18%	Positive
	Changing post op clinic visit resources	MD, PA, fellow	2.0%	83%	Neutral
Patient Value	Implementing post-op Day 1 call	MD, PA, patient	2.0%	93%	Positive
	Detailing interdepartmental operative reports	MD, nurse, patient	0.4%	100%	Neutral
	Relocating PT co-payment areas	Patient, admin.	1.0%	4%	Positive

Note. MD = physician; PACU = postacute care unit; OR = operating room; PT = physical therapist; PA = physician assistant.

day following surgery. The surgeon also set aside more time for case preparation prior to the case to ensure that imaging was available on the day of surgery and to prevent consequent delays. Finally, the surgeon provided more detailed operative notes for physical therapists, which reduced the need for calls following the surgery to discuss care protocols. Implementing workflow changes to address these identified process improvements yielded an estimated 8.5% cost savings in the first few months following the group's project.

Over a four-year period, a project team at MD Anderson Cancer Center performed several reengineering cycles in its Anesthesia Assessment Center (AAC). The changes reduced average patient processing time by 33% and reduced personnel costs per assessment by 46%, even after employee compensation increased an average of 10% over that period. The AAC could now see 19% more patients with 17% fewer employees without any degradation in patient outcomes. The changes included the transfer of two of the four anesthesiologists, previously staffing the center, to providing direct patient care in the operating room prior to and during oncology surgeries (French et al., 2013).

The success of the initial analysis at the AAC spurred the decision to scale TDABC analyses throughout MD Anderson. The value improvement opportunities identified by these follow-on projects include a 14% cost savings in implantable venous access system placement, an 8% savings in pediatric bone marrow aspiration, and a 12% savings in processes related to pediatric proton therapy. The process improvement and outcomes measurement phases of these projects are ongoing.

Multifacility Benchmarking and Best Practice Sharing

Schön Klinik, a for-profit 16-hospital group in Germany with a 30-year history of outcome measurements, was a natural setting at which to apply internal benchmarking of its TDABC costs. The Schön project team started by modeling acute and rehabilitation care for total-knee-replacement patients at its high-volume Neustadt location. The project leaders learned from this initial study that several overhead costs, such as space and medical billing, had been misallocated. By using more clinically relevant drivers, the rehabilitation facility, formerly thought to be losing money or, at best, to be breaking even, turned out to be a valuable profit contributor, a finding that had significant implications for the retention and expansion of this service line.

Next, the team studied a focused rehabilitation facility, where it learned about major opportunities to lower the cost and improve rehab outcomes at its original Neustadt site. In a study of a third facility, which also performed a high volume of total knee replacements, the team found personnel and indirect costs more than 25% higher than Neustadt's, along with slightly poorer outcomes. The much higher costs were caused by productivity differences (more personnel time per patient), not input price differences (in capacity cost rates), between the two facilities. The Schön experience illustrates the opportunities for using TDABC analysis to identify multiple opportunities for best

practice sharing and care pathway standardization that lower total system costs significantly while also improving outcomes (Kaplan, Witkowski, & Hohman, 2012).

DISCUSSION

Cost-Reduction Opportunity

Project personnel at all sites noted that TDABC gave great visibility for using the appropriate personnel at each activity step. Healthcare personnel have widely differing capacity cost rates, ranging from experienced surgeons, whose rates could be in the $5.00- to $10.00-per-minute range, through nursing personnel at $0.80 to $1.50 per minute (depending on the region), to administrative staff at $0.60 to $1.00 per minute. Healthcare is almost unique in having personnel with cost variations of more than 10:1 between the most highly and least highly paid staff who actually produce and deliver services. Even if each person works efficiently and at capacity, having a $6-per-minute clinician perform a task that could be equally well performed by a $1-per-minute employee is an inefficient use of resources. The TDABC personnel costing rates created awareness for designing clinical and administrative processes so that each person ideally worked at the top of his or her license. A lower-paid person could take 40% longer to accomplish the same task currently performed by someone paid 3 or 4 times as much, and the organization would still lower its overall costs.

A combination of work reassignments and better managing each resource's capacity utilization will ultimately enable providers to deliver the same (or better) outcomes with fewer personnel and with a lower average cost mix of personnel. This effect is well illustrated by MD Anderson's AAC experience, where the redesigned process used fewer and less expensive personnel to handle nearly 20% more patients with no outcome degradation.

Project Sponsorship and Leadership

The pilot sites, despite their different sizes, structures, and clinical conditions studied, shared several important characteristics: executive project sponsorship, engaged clinical leaders and financial managers, and dedicated project management. Executive sponsors at the provider organizations were typically senior executive or medical officers. Senior financial managers assigned personnel to collect and compile data for the calculation of capacity cost rates and total care cycle costs. Clinical leaders, such as attending physicians and department chiefs, mobilized other clinicians to provide the data necessary to complete the process maps. As part of the teams that developed the process maps, clinicians were intimately involved in estimating the TDABC costs. They readily accepted that the TDABC approach produced valid costs of the actual processes they were currently using to deliver care, and subsequently they proposed changes that would reduce costs while maintaining or improving outcomes. Project managers executed the tasks assigned by clinical and financial managers and coordinated the interactions between these typically disconnected personnel.

Organizations that lacked clinical and executive leadership struggled to complete their costing study. For example, several organizations had a highly motivated clinician as their project sponsor, but because of resistance or apathy from financial managers, they could never access financial data and, hence, were ultimately unable to calculate capacity cost rates. Other sites led by strong executive managers struggled to complete TDABC projects because they lacked the input of clinician leaders.

Another facilitator was to have teams focus either on a discrete process within a complete cycle of care or on an episodic care cycle, enabling them to generate cost estimates more quickly. The relatively short care cycle for a discrete condition provided clear focus for their work. Several pilot sites are currently extending their initial focus to encompass total costs for a care cycle delivered over longer timelines, such as repeated outpatient treatments for a chronic condition.

Several pilot project executive sponsors also noted that the impetus to participate in a TDABC pilot was to prepare for new reimbursement approaches, particularly bundled payments. Before offering fixed-price contracts to cover a complete cycle of care, they wanted to understand the total costs of all the resources that would be used in the care cycle. These executives also believed that the granular view of the quantity of time that each clinician dedicated to the care cycle would facilitate a rational distribution of the bundled payment among the multiple clinicians and clinical departments involved in the care cycle.

Barriers

As already noted, several of the pilot sites had not implemented the value improvement opportunities they identified. The major barrier was the misaligned fee-for-service reimbursement system, which encouraged high-cost, potentially inefficient care. For example, in the Boston Children's pediatric plastic surgeons' experience, changing the patient's admission status from ICU to an alternative form of monitoring had significant coding and billing implications. Also, if task assignments shifted from physicians to mid-level providers or registered nurses, the provider's reimbursement could decrease. Thus, the existing fee-for-service payment scheme proved to be a significant barrier for hospital leaders and clinicians to implement process changes that lowered payments by more than the immediate cost savings.

Other than the comprehensive analysis performed at MD Anderson's AAC, the pilot projects analyzed only one clinical condition among the many that the staff were performing. Therefore, the process improvements just for that condition were not sufficient to enable an immediate change in staffing levels. As providers extend their TDABC analyses to all the clinical conditions performed by a department or an integrated practice unit, clinical and executive leadership will be able to adjust staffing levels, mix, and assignments to lower the actual spending required to deliver the desired quantity and quality of care.

CONCLUSION

The simplest way to reduce a provider's costs is to impose across-the-board

spending cuts to all departments. But such arbitrary reductions could adversely affect access and healthcare outcomes. Sustainable cost reductions and better capacity utilization should be the result of bottom-up reengineering that enables the provider to maintain and improve its healthcare outcomes and serve a larger patient population with the same resources. Such sustainable reengineering must be based on valid calculations of the total cost of delivering care over complete treatment cycles.

The U.S. and European pilot projects discussed in this article show that healthcare provider organizations can use the TDABC approach to identify many short- and longer-term value improvement opportunities. To realize substantial and sustainable reductions in the organization's care delivery costs, however, requires that TDABC be scaled to all the high-volume and high-cost medical conditions. Achieving significant cost reductions is analogous to learning integral calculus. Students calculate areas and volumes by adding up many little slivers that eventually accumulate to a significant quantity. In healthcare, no single improvement will make a noticeable difference in total spending, but enacting thousands of improvements in a consistent, replicable manner will enable providers, over time, to incur much lower total costs for delivering the same or better clinical care.

For this new approach to be widely accepted, providers must have the confidence that their reimbursements will cover all the costs they expect to incur when treating patients efficiently and effectively over the care cycle for their medical conditions. Bundled payment reimbursement has the potential to motivate providers to deliver healthcare efficiently, to minimize or eliminate complications, and to optimize outcomes (Hackbarth, Reischauer, & Mutti, 2008; Miller, 2009; Mechanic & Altman, 2009). Experimentation is currently under way with value-based payment models (Witkowski, Higgins, Warner, Sherman, & Kaplan, 2013). Physicians and clinical staff members participating in these projects will have the incentive to redesign their care processes, eliminate process steps and variations that do not lead to improved patient outcomes, and make staffing changes and substitutions that have all personnel working at the top of their capabilities. The net result will be sustainable improvements in costs and a focus on delivering better outcomes for patients.

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PRACTITIONER APPLICATION

Joyce T. Siegele, FACHE, director, Productivity Management, Northside Hospital, Atlanta, Georgia

As I read this article's title, I could not help but think back to when I first used activity-based costing on one of my first projects as a healthcare consultant more than 18 years ago. For that project, I focused on determining the cost allocation for each procedure or activity in each department of the healthcare organization in the categories of labor, supply, and capital. While I was able to allocate costs at the procedural level, the allocation was dependent on establishing weighted ratios. The method described in the article by Kaplan et al., time-driven activity-based costing (TDABC), takes the traditional activity-based costing one step further—into process mapping—to identify the actual cost of each component of the process. This method

enables healthcare organizations to evaluate the value and impact of each process improvement. Unfortunately, this critical step can be overlooked.

As healthcare organizations face the ever-changing and challenging initiatives of reducing cost and improving value, the unique methodology proposed in this article could not be more timely. This method could assist healthcare organizations in meeting the challenges that accompany meaningful use, value-based purchasing, and other shifts in care delivery triggered by the Affordable Care Act.

Healthcare organizations have begun to determine the cost of certain procedures through process mapping and costing so they may improve efficiency, establish better patient outcomes, and determine appropriate pricing. Northside Hospital has undertaken such a project with total joint (hip and knee) replacements, and I believe we could use this methodology for costing related to the process mapping effort. By applying TCABC, we would be able to further identify opportunities for improvements and demonstrate the cost impact of implementing them. We could also enhance our ability to collaborate with other healthcare organizations to benchmark opportunities for increasing efficiency.

With the Lean and Six Sigma process improvement methodologies becoming more prevalent in the healthcare setting, TCABC can be used to quantify the results of improvement projects. Where value stream mapping and root cause analyses are performed, TDABC can help identify the areas in which the largest cost improvement could be made.

I thoroughly enjoyed the authors' explanation of the method and several relevant examples in multiple healthcare settings. In particular, I gained insight from the example of ensuring that the X-ray orders were clear and consistent to reduce delays and cost. This is just one among innumerable examples of how using TDABC will allow a healthcare organization to effect clinical and financial improvement and ultimately improve the quality of care provided to patients.