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Measuring the cost of care in benign prostatic hyperplasia using time-driven activity-based costing (TDABC)

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ABSTRACT

Background: Determining '"value"' in health care, defined as outcomes per unit cost, depends on accurately measuring cost. We used time-driven activity-based costing (TDABC) to determine the cost of care in men with benign prostatic hyperplasia (BPH) – a common urologic condition.
Methods: We implemented TDABC across the entire care pathway for BPH including primary and specialist care in both inpatient and outpatient settings. A team of expert stakeholders created detailed process maps, determined space and product costs, and calculated personnel capacity cost rates. A model pathway was derived from practice guidelines and calculated costs were applied.
Results: Although listed as 'optional' in practice guidelines, invasive diagnostic testing can increase costs by 150% compared with the standalone urology clinic visit. Of five different surgical options, a 400% cost discrepancy exists between the most and least expensive treatments.
Conclusions: TDABC can be used to measure cost across an entire care pathway in a large academic medical center. Sizable cost variation exists between diagnostic and surgical modalities for men with BPH.
Implications: As financial risk is shifted toward providers, understanding the cost of care will be vital. Future work is needed to determine outcome discrepancy between the diagnostic and surgical modalities in BPH.

1. Introduction

The importance of "value", defined as the health outcomes achieved per dollar spent, is becoming increasingly recognized in American health care.[1,2] Measuring and improving *outcomes* – the numerator in the value equation – has predominated health services research while investigation into cost containment has largely failed to consider the value of care.[3,4] An isolated focus on outcomes without a similarly rigorous approach to understanding costs may fail to "move the needle" in value measurement in health care and warrants further investigation.

Providers are increasingly called upon to enter into alternative payment models, such as bundled payments or participation in accountable care organizations. In these paradigms the clinician's ability to accurately measure and report the value of his/her care will be pivotal to success.[5] Likewise, health care organizations must be able to document the value of their care across care pathways over time. Traditional costing strategies use advanced accounting calculations to allocate resource costs to products based on consumption. This affords managers greater visibility into organizational processes and cost drivers. By knowing the drivers of cost, managers can eliminate costs related to non-value added activities and improve efficiency.[6] These strategies are hospital-based, cumbersome, often breakdown in the face of complex health care encounters, and yield poor approximation of total expenditures.[6,7] To address the limitations of these modalities, health care economists at Harvard Business School developed a novel costing strategy that may more accurately estimate true cost.[6]

Time-driven activity-based costing (TDABC) relies on managerial estimates of resource demands imposed by each encounter, product, or patient.[6] Traditional activity-based costing relies on individual employee surveys and interviews to estimate the

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percentage of time spent on an activity.[6] The excessive cost and time required to conduct repeated interviews and surveys have been a major barrier to widespread adoption in service and health care industries.[6] The novel time estimating equations and managerial input used in TDABC allow for multiple time drivers to be considered, more aptly capturing the complexities of health care. In a 2009 case study describing TDABC implementation in the clinic setting, Demeere and colleagues found that the strategy enlightened managers and department chairs about the cost drivers and inefficiencies in their system which led to process improvement and strategies to reign in cost.[8] TDABC has shown promise across multiple health care settings, including medical, surgical, outpatient clinic and hospital.[3,6] To our knowledge, this methodology has not been used to analyze an entire care pathway within a large health system.

Lower urinary tract symptoms (LUTS) due to benign prostatic hyperplasia (BPH) is one of the commonest diagnoses in adult urology and accounts for a considerable proportion of the cost of urologic care.[9] As a part of a greater effort to improve value at our institution, we implemented TDABC to assess the cost of BPH across the entire care pathway, from initial primary care visit to urologic consultation through surgical intervention. Our ultimate goal is to understand the processes and variation that drive cost in BPH care, which we will couple with rigorous outcomes assessment; thereby achieving a comprehensive value analysis. We hypothesized that implementing the method would be feasible and that we would identify significant cost variation between the different diagnostic and surgical procedures.

2. Methods

To determine BPH costs, we used the TDABC method as described by Kaplan and Anderson[6]: (1) process mapping to define each step in the BPH care pathway including time estimates per step, (2) calculate personnel capacity cost rates, and (3) calculate space and equipment costs. To compare diagnostic and surgical modalities according to cost, we then created a simplified model pathway based on practice guidelines. Calculated costs were then applied to the model for each of the various diagnostic and surgical modalities for comparison.

2.1. TDABC Step 1: Process mapping

Borrowed from industry, process mapping refers to the development of flow charts listing each activity involved in a workflow. In health care quality improvement, process mapping is a methodical and graphical explanation of all the steps in a care pathway (e.g. patient calls clinic to make an appointment). To define the processes in BPH care, we assembled a team of expert stakeholders from the University of California, Los Angeles Health System. The team was comprised of providers involved in each step of the BPH care pathway, including urologists, primary care physicians (PCP), clinic, inpatient, and operative nurse managers, and representatives from patient affairs and scheduling. The care pathway encompassed all patient–health provider interactions from the first onset of BPH symptoms to the last follow-up appointment after surgical treatment. Over the course of three meetings, the team created detailed process maps to account for each potential encounter in the care pathway.

Medical management was defined as treatment by PCP, urologist, or both. Non-invasive diagnostic testing included urinalysis, PSA measurement, uroflowmetry, and post-void residual (PVR) measurement. Invasive diagnostics were defined as cystoscopy, urodynamics (UDS) or transrectal ultrasound (TRUS). Surgical procedures – further stratified as inpatient or outpatient – were transurethral resection of prostate with monopolar current (TURP), electrovaporization of prostate with bipolar current (EVP), photovaporization of prostate with laser (PVP), open simple prostatectomy, and robotic simple prostatectomy.

We identified all personnel, personnel activities, consumable supplies, facility space and equipment that were utilized during BPH patient encounters. After identifying the components of each encounter in the pathway, including the activities involved with each encounter, we defined usual patient flow and time estimates for each activity, e.g. the time a nurse spends cleaning/setting up uroflowmeter or time anesthesiology resident takes to place spinal block prior to TURP. When time estimates differed between providers an average estimate was employed. Using these beginning- and end-points, we created a process map to identify the sequence of events and time for each activity in the BPH care pathway.

2.2. TDABC Step 2: Personnel capacity cost calculation

Capacity cost rates – in dollars per minute – were calculated for all personnel using financial data obtained by departmental human resources. Personnel compensation was adjusted to account for the cost of benefits, administrative support, training and travel, office space, hardware and support, office expenses, and malpractice insurance. *Per Diem* personnel were excluded from all calculations. Urologic personnel included in the analysis were 30 full-time clinical faculty, 18 residents, 10 fellows, 2 nurse practitioners, registered nurses, licensed vocational nurses, medical assistants, technicians, and administrative staff. Capacity estimates incorporate both direct and indirect patient care. Urology attending physicians were estimated to work 10.5 h per day, including work from home. All other personnel were estimated to work 8 h per day. Vacation time, sick and personal leave, weekends/holidays and educational time were accounted for in the analysis. Time spent engaged in clinical activity while physicians were on-call was estimated at 20%.

2.3. TDABC Step 3: Space and product cost calculation

Space costs were calculated by physically measuring the clinic square footage that is devoted to treating BPH patients and allocating a proportionate percentage of the monthly rent. Construction and renovation costs were incorporated as well. Costs for all equipment and materials were obtained from clinic managers, materials management, facilities and operative services. Clinic and hospital space costs (e.g. rent) were obtained from departmental and Health System administration, respectively. Equipment and space costs – in dollars per minute – were determined using capacity cost equations while product costs were by estimated number of items used (e.g. number of disposable surgical instruments used during an operation). Equipment (e.g. office-based ultrasound machine) capacity cost incorporated depreciation, maintenance, and utilities in the equation.

2.4. Cost modeling to compare diagnostic and surgical modalities

The preoperative evaluation for BPH can range from history and physical examination coupled with non-invasive uroflowmetry to invasive procedural testing – cystoscopy, UDS, TRUS. The American Urological Association (AUA) practice guidelines for BPH list these invasive tests as optional.[10] Additionally, there are multiple surgical modalities that exist to treat BPH that has failed medical management. To eliminate unnecessary variation in diagnostic and surgical BPH care, we sought to compare TDABC-derived costs associated with each of the modalities.

A simplified model BPH care pathway was derived from AUA guideline recommendations and represents the “minimalist”