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Clinical-Bladder cancer

Utilizing time-driven activity-based costing to determine open radical cystectomy and ileal conduit surgical episode cost drivers

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Abstract

Objectives: Patients undergoing radical cystectomy represent a particularly resource-intensive patient population. Time-driven activity based costing (TDABC) assigns time to events and then costs are based on the people involved in providing care for specific events. To determine the major cost drivers of radical cystectomy care we used a TDABC analysis for the cystectomy care pathway.

Subjects and methods: We retrospectively reviewed a random sample of 100 patients out of 717 eligible patients undergoing open radical cystectomy and ileal conduit for bladder cancer at our institution between 2012 and 2015. We defined the cycle of care as beginning at the preoperative clinic visit and ending with the 90-day postoperative clinic visit. TDABC was carried out with construction of detailed process maps. Capacity cost rates were calculated and the care cycle was divided into 3 phases: surgical, inpatient, and readmissions. Costs were normalized to the lowest cost driver within the cohort.

Results: The mean length of stay was 6.9 days. Total inpatient care was the main driver of cost for radical cystectomy making up 32% of the total costs. Inpatient costs were mainly driven by inpatient staff care (76%). Readmissions were responsible for 29% of costs. Surgery was 31% of the costs, with the majority derived from operating room staff costs (65%).

Conclusion: The major driver of cost in a radical cystectomy pathway is the inpatient stay, closely followed by operating room costs. Surgical costs, inpatient care and readmissions all remain significant sources of expense for cystectomy and efforts to reduce cystectomy costs should be focused in these areas.

Keywords: Bladder cancer; Cystectomy; Cost-benefit analysis; Health care costs; Delivery of healthcare/economics; Patient care/economics; Value-based healthcare delivery; Costs of Care

1. Introduction

Bladder cancer has been cited as the most expensive cancer to care for from diagnosis to death [1]. Of the patients with bladder cancer, patients undergoing radical cystectomy represent a particularly resource-intensive patient population with 30% readmission and 60% complication rates [2,3]. In 2020, it is projected that the total amount spent caring for bladder cancer patients will exceed $4.9 billion [4]. Although most of these costs will be for bladder cancer care other than cystectomy, it is clear that cystectomy is large expenditure in the care for bladder cancer, often with costs greater than $30,000 per episode [5]. In addition, associated complications increase the total costs to over $50,000 [5]. While bladder cancer care is expensive, a detailed understanding of what the main costs driving

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cystectomy are in the first 90 days after the procedure is lacking.

U.S. health care costs currently exceed 17% of gross domestic product and continue to rise [6]. Overall, the American healthcare system is in the midst of a radical overhaul with rising healthcare costs cited as the leading cause for mandated change [6]. One way to study the costs of medical care is a time-driven activity-based costing (TDABC) model. The TDABC method follows a patient through the continuum of care and allows the actual costs of the resources used to be accounted for based on the amount of time the patient spends with each resource [7]. The TDABC method allows the measurement of the cost rather than the values billed or charged to the patient and insurance [6]. By measuring the entire process and focusing on each resource utilized during the course of patient care, the true costs are able to be elucidated to inform meaningful change. In addition the TDABC model allows for the review of major burdens to the systems where the costs are the largest (cost drivers) [6]. We performed a TDABC analysis for the 90-day episode in a cystectomy care pathway to determine the major drivers of cost surrounding radical cystectomy.

2. Subjects and methods

2.1. Patients

For inclusion in the study patients had to undergo an open radical cystectomy with lymph node dissection and ileal conduit urinary diversion for bladder cancer without other concomitant procedures. Ileal conduit and open cystectomy were chosen because they were the most common operations performed with the most reliable postoperative pathway for recovery and discharge. Because the TDABC process is time consuming, of the 717 patients who qualified for inclusion, 100 were randomly selected for further analysis.

To provide a balanced representation of patients undergoing radical cystectomy and the impact of enhanced recovery pathways, which can significantly change the length of stay (LOS), half of the patients randomly selected were classified as being on an early discharge program and the other half were treated under traditional care. All surgeons were fellowship trained urologic oncologists at a single large volume referral center. This was approved by an internal review board.

2.2. Primary objective

The primary objective was to use the TDABC method to find the primary driver of cost in the 90-day care cycle for a bladder cancer patient undergoing radical cystectomy with a secondary analysis focused on the impact of enhanced recovery pathways on costs among this population. Since most enhanced recovery pathways decrease LOS by 2 days, 2 days was used to illustrate cost reductions [8−10].

2.3. Study design and outcome measures

We performed a retrospective study from 2012 to 2015 at a large academic referral center. The outcome measure was defined by the TDABC value over the entire 90-day radical cystectomy care cycle. We defined the cycle of care as beginning at the preoperative clinic visit and ending with the 90-day postoperative clinic visit. TDABC was carried out with construction of detailed process maps with time expended for each step of this care cycle. Each process map was created with direct observation of the tasks and individuals performing the tasks. Direct observation was done for each process map process for at least patients entering each process and mean times were rounded to the nearest minute and used to create the process maps.

Analysis was carried out with individual cost events and phases of care. The individual cost events included the preoperative visit, day of surgery preparation, surgery, surgery consumables, daily postoperative care, inpatient consumables, home medications, outpatient postoperative day 30 (POD30) visit, outpatient postoperative day 90 (POD90) visit, and readmissions (including inpatient days, consumables, and procedures). The care cycle was divided into 3 phases: surgical, inpatient, and readmissions. Specific readmission complications were broken down into the following categories: infectious, gastrointestinal, failure to thrive/dehydration, and wound complications. Patients readmitted for the purpose of receiving adjuvant chemotherapy were removed from the readmission TDABC analysis.

2.4. Statistical analysis

Capacity cost rates were calculated (salary/available working hours). Total costs were calculated (time elapsed × capacity cost rate) for every process step. Additionally, mean consumable costs and overhead expenses were taken into account. Costs were normalized to the cohort's lowest cost driver and then a scale of 0 to 100 for percent costs attributable to each event. Both percent and normalized costs were reported to represent the cost burdens.

3. Results

The mean LOS was 6.9 days. The mean patient age was 69 and 79% were men. Half of the patients were classified as enhanced recovery and the other half treated with traditional care. The rate of readmissions were 29% and the majority of the procedures were done by 3 surgeons. Table 1 shows the demographic details.

Outpatient costs (home medications/supplies, outpatient preoperative, POD30, and POD90 postoperative visits) made up 3% of the costs with a normalized cost value of 14.2. These were removed from later calculations because they were negligible compared to the other cost drivers.

Table 1
This table details the patient demographics, readmission details and pathologic outcomes.

Variable	N = 100
Demographics[a]	
Age, Med (IQR)	68.5 (60.8−74.3)
Sex, Male	79
Neoadjuvant chemotherapy	51
ASA Class	
1-2	12
3	74
4	14
Surgery details	
Median LOS	6 (5−8)
Mean LOS	6.9
Enhanced recovery	
Yes	50
No	50
Surgeon	
1	27
2	20
3	49
4	4
Readmission details[b]	
Readmissions	29
Mean LOS for readmissions	4.7
Median LOS for readmission (IQR)	3 (2−7)
Readmission complications (out of 29 readmissions)	
Anemia	1 (5%)
Cardiovascular	2 (7%)
Infection	14 (48%)
GI	1 (5%)
Other	1 (5%)
Renal	2 (7%)
Surgical	5 (17%)
Procedures required during readmission (out of 29 readmissions)	
IR procedure	14 (48%)
Surgical procedure	5 (17%)
Pathology	
T0	33
Ta, CIS, T1	22
T2	13
T3	24
T4	8
N+	19

[a] All are out of the 100 patients included in the study.
[b] Some patients had more than one readmission, each counted as one readmission.

Total inpatient care was the main driver of cost for radical cystectomy care making up 32% of the total costs. Inpatient costs were mainly driven by inpatient staff care at 76%. Of the inpatient staff, nursing costs ranked highest at 68% of all inpatient costs with nursing assistants contributing the remaining 8%. Consumables accounted for 17% of costs, thus, making inpatient care the largest cost driver. Fig. 1 demonstrates the breakdown of these costs. The inpatient normalized costs were with 49.7 from inpatient staff care.

Surgery contributed 31% of the costs, with the majority derived from operating room staff costs at 71% (22% of the total cost). The breakdown of operating room staff included the urologist (28%), certified registered nurse anesthetist (20%) and nursing (17%). Consumables made up only 12% of these costs. Fig. 2 shows the details of the cost drivers of surgery. The normalized cost for surgery were 82.1 with the staff costs at 58.6.

Readmissions were responsible for 29% of the costs. Again the costs of the readmission were mainly driven by nursing care (58%). Procedures accounted for 18% and consumables 14%. Fig. 3 details the cost drivers for readmissions. Readmissions were responsible for a relative 76.9 cost units, see Table 1 for details.

Fig. 4 shows a decrease in LOS of 2 days and the impact on continuum of care costs. Most enhanced recovery

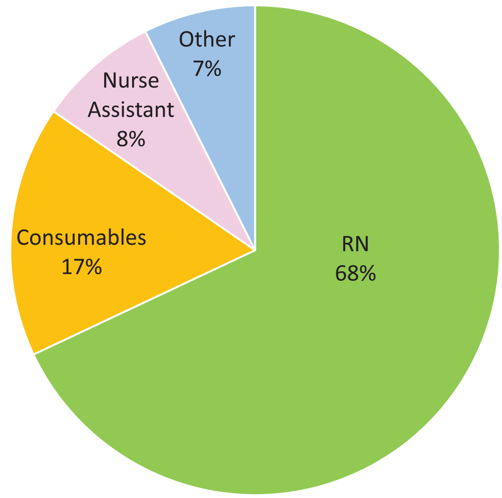

Fig. 1. Total inpatient care was the main driver of cost for radical cystectomy care making up 32% of the total costs. Inpatient costs were mainly driven by inpatient staff care at 76%. Of the inpatient staff, nursing costs ranked highest at 68% of all inpatient costs with nursing assistants contributed the remaining 8%. Consumables accounted for 17% of costs. Thus making inpatient care the largest cost driver.

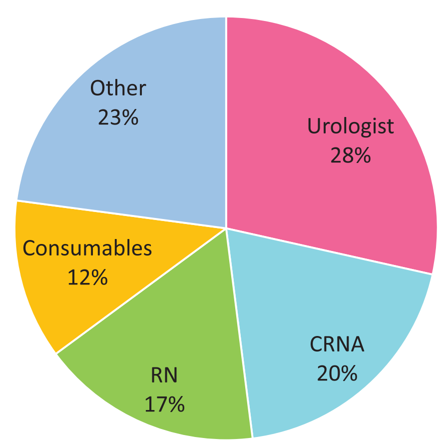

Fig. 2. Surgery contributed 31% of the total costs, with the majority derived from operating room staff costs at 71% (22% of the total cost). The breakdown of operating room staff included the urologist (28%), certified registered nurse anesthetist (20%) and nursing (17%). Consumables made up only 12% of these costs.

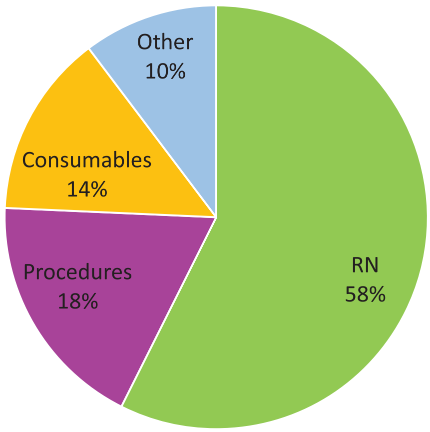

Fig. 3. Readmissions were responsible 29% of the total costs. The costs of the readmission were mainly driven by nursing care (58%). Procedures accounted for 18% (Interventional radiology or return to the operating room) and consumables 14%.

programs see at least a 2 day reduction in LOS, so 2 days was used to demonstrate cost reductions that can be accomplished with saving 2 hospital days.

4. Discussion

In this study, we found the main cost driver in the care cycle for radical cystectomy is the inpatient care at 32% of the total costs. The majority of the inpatient costs were attributed to staff who care for the patient. The majority of the costs are driven by nursing care for the initial inpatient (68% of costs) and readmissions (58% of costs) [11].

A transition to discussing cystectomy on a value based costing system can help providers use and allocate the necessary resources for delivering care for a cystectomy [12]. Focusing on the value of cystectomy care can help provide effective, patient-centered and timely care for patients and all payers [13].

Using TDABC can help redesign care models in a more cost conscious manner [14]. For example, for cystectomy using the information based on the cost drivers found in this study, moving as much noncritical care to the outpatient setting would decrease overall costs based on the results of this study. For example, the time spent on patient education, commonly performed during the inpatient stay, could be primarily delivered in the outpatient setting and bolstered as needed during the inpatient stay. In addition anything that can be done to decrease LOS will lower initial admission costs, and therefore supports programs such as enhanced recovery pathways. Specific recommendations to decrease length of costs include implementing enhanced recovery after surgery principles [15,16]. Movement toward an intense homecare follow-up schedule and early preemptive office visits may also decrease costs. While determining value in health care is difficult, TDABC helps aid in identifying areas where major costs are allocated and can be focused on in the care cycle of cystectomy [17].

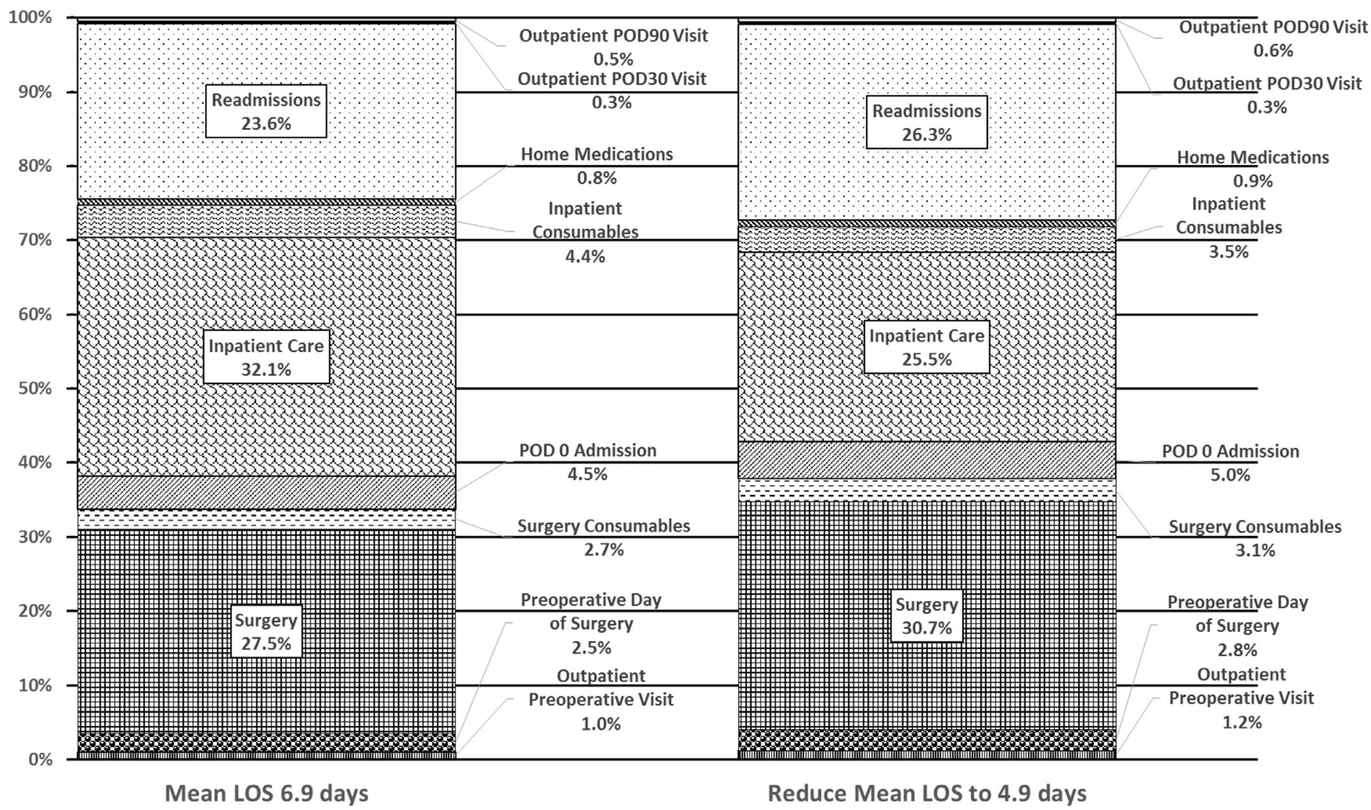

Fig. 4. This figure demonstrates the value of reducing length of stay by 2 days (average of what most ERAS programs produce) and how the costs shift when length of stay is decreased.

A major limitation is that this costing system is new and not readily recognized by payers and hospital systems [18]. Limitations include the retrospective nature of the study and inability to account for complications during the initial hospitalization in the TDABC due to small number of patients. However, this simulates the real world cystectomy care cycle and provides a direct insight into how costs are realized by the health care system. It would be expected that costs vary based on location, health care system and patient population, however, most of the variation for a TDABC method would be from the compensation for employees, so likely mostly secondary to cost of living adjustments and years experience. Complications during the initial postoperative hospitalization were not able to be further defined for their TDABC costs. Additionally, although this a single center study with only ileal conduits, which may skew the overall results in a direction different from other urinary diversions it also represents the most common form of surgery experienced by patients. Another major limitation includes the lack of robotic cystectomy inclusion, where length of stay maybe shorter, but the costs maybe higher overall. Strengths include that all patients underwent the same procedure, where the majority of patients were operated by 3 fellowship trained surgeons. Equal enhanced recovery and nonenhanced recovery inclusion establishing costs in both models of patient care. There was no selection bias in those chosen from a large group. The process maps were very detailed for each step, thus the chance of missing a significant cost component was low.

5. Conclusion

The major driver of cost in a radical cystectomy pathway is the inpatient stay, closely followed by operating room costs. Surgical costs, inpatient care and readmissions all remain significant sources of expense for cystectomy and efforts to reduce cystectomy costs should be focused in these areas.

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