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Defining the value framework for prostate brachytherapy using patient-centered outcome metrics and time-driven activity-based costing

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ABSTRACT

PURPOSE: Value, defined as outcomes over costs, has been proposed as a measure to evaluate prostate cancer (PCa) treatments. We analyzed standardized outcomes and time-driven activity-based costing (TDABC) for prostate brachytherapy (PBT) to define a value framework.

METHODS AND MATERIALS: Patients with low-risk PCa treated with low-dose-rate PBT between 1998 and 2009 were included. Outcomes were recorded according to the International Consortium for Health Outcomes Measurement standard set, which includes acute toxicity, patient-reported outcomes, and recurrence and survival outcomes. Patient-level costs to 1 year after PBT were collected using TDABC. Process mapping and radar chart analyses were conducted to visualize this value framework.

RESULTS: A total of 238 men were eligible for analysis. Median age was 64 (range, 46−81). Median followup was 5 years (0.5−12.1). There were no acute Grade 3−5 complications. Expanded Prostate Cancer Index Composite 50 scores were favorable, with no clinically significant changes from baseline to last followup at 48 months for urinary incontinence/bother, bowel bother, sexual function, and vitality. Ten-year outcomes were favorable, including biochemical failure-free survival of 84.1%, metastasis-free survival 99.6%, PCa-specific survival 100%, and overall survival 88.6%. TDABC analysis demonstrated low resource utilization for PBT, with 41% and 10% of costs occurring in the operating room and with the MRI scan, respectively. The radar chart allowed direct visualization of outcomes and costs.

CONCLUSIONS: We successfully created a visual framework to define the value of PBT using the International Consortium for Health Outcomes Measurement standard set and TDABC costs. PBT is associated with excellent outcomes and low costs. Widespread adoption of this methodology will enable value comparisons across providers, institutions, and treatment modalities.

Keywords: Value; Prostate; Brachytherapy; Outcomes; Time-driven activity-based costing; TDABC

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Introduction

Direct medical costs of cancer care, including costs for localized prostate cancer (PCa) (1), have risen dramatically (2, 3) and have nearly doubled between 1987 and 2005, approaching nearly $125 billion annually. PCa can be treated with a variety of treatment modalities, including active surveillance, brachytherapy (PBT), intensity-modulated radiation therapy (IMRT), proton therapy, or radical prostatectomy. Despite the steep rise in cost, there has been little evidence of a rise in clinical outcomes (4–6). In reality, recent studies have shown that reimbursement incentives under the current fee-for-service (FFS) system have, in part, led to the decreased utilization of cost-effective modalities, such as PBT (6, 7), and simultaneous increase in use of more expensive alternatives, such as IMRT (8). Increasingly, payment for cancer care will be moving away from FFS and toward value-based payment (9), defined by better outcomes achieved at lower financial cost.

At the core of suboptimal outcomes and higher costs is a measurement gap, where validated and accepted outcome and costing metrics are not systematically collected or reported for patients treated for PCa over the full cycle of care. Porter *et al.* have advocated that treatments for medical conditions be evaluated by the value they create for patients (10, 11). Providers have been unable to implement the value framework because of inconsistent collection and reporting of outcome metrics by medical condition, particularly patient-reported outcomes (PROs). Providers also do not collect accurate cost data by medical condition across a patient's care cycle. As a result, providers cannot compare outcomes and costs across institutions to identify and implement best practices that could increase the value of care delivery.

This paucity of valid value-based measurements, however, is changing. The International Consortium for Health Outcomes Measurement (ICHOM) (12) has recently defined a standardized set of rigorous and multidimensional outcome metrics that potentially sets a modern standard for all men with localized PCa and holds promise for clinical comparisons across the health care system.

Historically, studies assessing the cost of various treatment modalities have focused on reimbursed costs rather than actual resource utilization throughout the entire cycle of patient care. The current FFS system has led to a focus on volume over value (13), cross-subsidization of undervalued services, and fragmentation of health care services with little incentive to improve coordination between provider groups (14–16). Time-driven activity-based costing (TDABC) has been introduced to health care to remedy these problems (17, 18). TDABC is a bottom-up costing tool that measures resource utilization over the full cycle of patient care to determine the true cost of delivering care to the provider (19–21). This methodology has been successfully used by several industries (17, 18), and more recently, TDABC has been used to measure costs and drive process improvements in a variety of medical settings (22, 23).

This study is the first to apply the value framework for PCa treatment. We implement the ICHOM standard set and TDABC to define the standardized value framework for low-risk PCa, using PBT as a model example.

Methods and materials

Patient selection criteria

Patients with low-risk PCa treated with ^{125}I (98%) or ^{103}Pd (2%) PBT monotherapy between May 1998 and November 2009 were eligible for this institutional review board-approved analysis. Criteria for low-risk included: (*1*) pretreatment prostate-specific antigen (PSA) level ≤10 ng/mL; (*2*) Gleason score ≤ 6; and (*3*) American Joint Committee on Cancer (AJCC) seventh edition tumor status ≤ T2a. Information on tumor status and grade, initial serum PSA level, race, age, medical comorbidities, medications, survival, recurrence, and toxicity were prospectively added to an outcomes database. PROs were also prospectively collected but added to a separate outcomes database. All patients were treated definitively with monotherapeutic PBT, and most were prescribed doses of 144–145 Gy with a standard transrectal ultrasound-guided, transperineal technique with preloaded PBT needles as described previously (24, 25). No patient in this study received supplemental external beam radiation therapy or androgen deprivation therapy.

Measurement of patient-centered outcomes

The ICHOM standard set of patient-centered outcomes for localized PCa (12) was used to measure and report outcomes. These data were prospectively collected by the clinical and research staff. Major radiation complications were recorded via the Common Terminology Criteria for Adverse Events, version 4.0 (26) at 6 months after PBT, as defined by the ICHOM standard set. Patient-reported health status was recorded via the Expanded Prostate Cancer Index Composite (EPIC)-50 questionnaire (27, 28) given before initiation of PBT (i.e., baseline) and at regular followup intervals of 1, 4, 8, and 12 months after PBT and for every 6 months thereafter, as described previously (29). EPIC end points for urinary continence, urinary bother, bowel bother, sexual function, and hormonal function (vitality) were used at last followup to track PRO, as suggested by the ICHOM. EPIC scores were tabulated according to EPIC instrument guidelines scaled from 0 to 100, with higher scores representing better outcomes (28). Biochemical failure was based on the Phoenix Consensus Conference PSA elevation definition (30), and biochemical failure-free survival (bFFS), metastasis-free survival, prostate cancer–specific survival, and overall survival (OS) were recorded for survival and disease