



## Prostate Cancer

# High Radical Prostatectomy Surgical Volume is Related to Lower Radical Prostatectomy Total Hospital Charges

Alvaro Ramirez<sup>a,b</sup>, Serge Benayoun<sup>a,b</sup>, Alberto Briganti<sup>a</sup>, Jongi Chun<sup>a</sup>, Paul Perrotte<sup>b</sup>, Michael W. Kattan<sup>c</sup>, Markus Graefen<sup>d</sup>, Michael McCormack<sup>b</sup>, Alfred I. Neugut<sup>e</sup>, Fred Saad<sup>b</sup>, Pierre I. Karakiewicz<sup>a,\*</sup>

<sup>a</sup>Cancer Prognostics and Health Outcomes Unit, University of Montreal, Montreal, Quebec, Canada

<sup>b</sup>Department of Urology, University of Montreal, Montreal, Quebec, Canada

<sup>c</sup>Department of Quantitative Health Sciences, Cleveland Clinic Foundation, Cleveland, OH, USA

<sup>d</sup>Department of Urology, University of Hamburg, Hamburg, Germany

<sup>e</sup>Departments of Medicine and Epidemiology, Columbia University, New York, NY, USA

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### Abstract

**Objective:** To test the hypothesis that individual surgical volume (SV) is an independent predictor of radical prostatectomy (RP) total charges.

**Methods:** We used the Florida State Inpatient Data File. ICD-9 codes 60.5 (RP) and 185 (prostate cancer) identified all men treated with RP for prostate cancer between January 1 and December 31, 1998. Among 1,923,085 records, 3167 RPs were selected. SV represented the predictor. Total RP charges represented the outcome. Age, race, and comorbidity represented covariates. Univariate and multivariate linear regression models were used.

**Results:** All 3167 RPs were performed by 81 surgeons. SV ranged from 2 to 162 (mean, 68). Charges were \$4755 to \$140,201 (mean, \$18,200). In the multivariate model, each SV increment corresponding to one RP reduced hospital charges by \$25 ( $p \leq 0.001$ ).

**Conclusions:** Redistribution of RPs from low to high SV users could result in significant savings. For example, \$4 million could be saved if 1000 RPs were redistributed from surgeons with an SV of 18 to surgeons with an SV of 200.

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\* Corresponding author. Cancer Prognostics and Health Outcomes Unit, University of Montreal Health Network, 1058, rue St-Denis, Montreal, Quebec, Canada H2X 3J4. Tel. +1 514 890 8000x35336; Fax: +1 514 412 7411.

E-mail address: [pierre.karakiewicz@umontreal.ca](mailto:pierre.karakiewicz@umontreal.ca) (P.I. Karakiewicz).

## 1. Introduction

Several studies addressed the relationship between surgical volume (SV) and health indicators in an

attempt to support the “practice makes perfect” hypothesis [1–6]. Birkmeyer et al. [1] found that mortality decreased as hospital volume increased for 14 types of procedures, including cystectomy and

nephrectomy. The premise stating that higher patient volume will lead to greater expertise and that greater expertise may translate into better outcomes was confirmed in several analyses. These focused on major surgical procedures, such as esophagectomy, pancreaticoduodenectomy, craniotomy for cerebrovascular aneurysms, and pelvic exenteration [2]. However, when less complex procedures, such as cholecystectomy or arthroplasty, were analysed, the relationship between volume and outcome could no longer be shown. In addition to health outcomes, several studies focused on the relationship between patient volume and variables defining hospital charges and length of stay (LOS) associated with medical and surgical interventions [4–6]. Their findings suggest that high patient volume may reduce charges and LOS. However, radical prostatectomy (RP) total charges received less attention and only one study addressed the relationship between RP hospital volume and total charges [5]. We hypothesized that low RP surgical volume is a significant determinant of high RP total charges, after accounting for the confounding effects of age, race, and comorbidity. To test this hypothesis, we assessed the effect of individual surgeon volume on total RP charges, using the 1998 State of Florida Inpatient Data File.

## 2. Methods

We used the January 1 to December 31, 1998 State of Florida Inpatient Discharge Information Data File. The database contains information abstracted from patient medical records after discharge. Exceptions include free-standing psychiatric, rehabilitation, Veterans Administration, Bureau of Indian Affairs, and state-operated hospitals. Data collection in the participating institutions represents a mandatory process and is performed by trained professional coders. Prior to being made available to interested parties, data are audited for errors.

Elements of the data file that were made available to us consisted of patient identifiers, diagnosis and procedure identifiers, and an encrypted surgeon identifier. Diagnosis and procedure identifiers consisted of the principal diagnosis codes and the principal procedure codes. Patient identifiers consisted of age at admission, race, and comorbidity. Age was defined in years. Race was defined as white or other. Comorbidity was defined according nine secondary ICD-9 diagnostic codes. These were converted to the Charlson comorbidity index using the D'Hoore method, which was specifically developed for use with ICD-9 diagnostic codes found in administrative data [7].

The ICD-9 diagnostic and procedure code, respectively, identified 3167 patients treated with RP (ICD-9 60.5) for prostate cancer (ICD-9 185). The encrypted surgeon identifier allowed us to determine the SV for each urologic surgeon who performed at least one RP. SV represented the predictor

variable. Total charges in dollars for the procedure and hospitalisation, which were made available in the database, represented the outcome variable. Covariates consisted of age, race and comorbidity. Because the predictor and outcome variables represent continuously coded data, we used univariate and multivariate linear regression models to test the relationship between the predictor and the outcome. All data were modeled without transformations, because all distributions approximated the normal distribution, with the exception of hospital charges where a slight right-sided tail was noted. To comply with methodology used in similar analyses and based on the robustness of the normal theory, we relied on linear regression without data transformation [4]. All statistical tests were performed using the Statistical Package for Social Sciences version 10 (SPSS, Chicago, IL) and a two-sided statistical significance level of 0.05 was used.

## 3. Results

Between January 1 and December 31 1998, 3167 RPs were performed in participating Florida hospitals. Individual SV ranged from 2 to 162 RPs (mean, 68 with standard deviation [SD] 41) and is shown in Table 1. Average patient age was 63.5 yr (range, 38–83 yr). The majority (77.3%) of patients were white. Of all diagnostic codes used to define the Charlson comorbidity score, three code groups predominated. Hypertension and secondary hypertension were recorded in, respectively, 56.0% and 21.5% of patients. Unspecified effects of radiation, which include sunburns, were recorded in 8.6%. Other diagnostic codes were found in  $\leq 5\%$  of the population. Hospital charges ranged from \$4755 to \$140,201 (mean, \$18,200; median, \$16,600). The univariate

**Table 1 – Descriptive statistics**

Variable	
Individual surgeon surgical volume	
Mean (SD)	68 (41)
Range	2–162
Age, yr	
Mean (SD)	63 (7)
Range	38–83
Race	
White, %	77.3
Hospital charges (US \$)	
Mean (SD)	18,200 (8100)
Range	4755–140,201
ICD-9 comorbidity codes, %	
Hypertensive renal disease (403)	56
Secondary hypertension (405.3, 405.9)	21.5
Hypertensive heart disease (402.9)	5.1
Rheumatic fever (390, 391)	4.2
Hepatitis (573.2)	2.8
Hearing loss (389.3, 389.0)	2.0
Others	<1

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