Trends in Subspecialization Within Inpatient Urology From 1982 to 2012

Mark Finkelstein, Khawaja Bilal, and Michael Palese

OBJECTIVE To elucidate the evolving trends in subspecialization related to individual practice within inpatient urology over a 31-year period spanning from 1982 to 2012.

METHODS We conducted a retrospective cohort study by querying the centralized New York State data on partial nephrectomy, radical nephrectomy, radical prostatectomy, and radical cystectomy procedures for all inpatient encounters in the state of New York for the years 1982-2012 using the Statewide Planning and Research Cooperative System dataset. All encounters involving 1 of the procedures were identified and the AMA Masterfile was used to identify all physicians who have completed residencies in urology. We performed descriptive analyses to determine the quantity of cases, quantity of patients, and distribution of the cases among operating physicians. High-volume urologists, defined as the top 5% of urologists in terms of caseload, were identified, and the distributions of their procedures was analyzed.

RESULTS The proportion of procedures completed by high-volume urologists increased significantly for all procedures. The number of identified urologists involved in radical cystectomy and radical nephrectomy has declined since 1982, with the number of identified urologists involved in partial nephrectomy and radical prostatectomy beginning a continuous decline from 2004 to 1999, respectively. During the 31-year time period, the number of cases increased for all procedures.

CONCLUSION A smaller group of urologists is performing a larger proportion of cases for each studied procedure, reflecting a trend toward subspecialization. UROLOGY ■■: ■■–■■, 2016. © 2016 Elsevier Inc.

A variety of factors has contributed to changes in individual urologic practice styles. Urologists are now older, retiring later than ever before, and seeing more patients in the office every year.[1,2] There have been several reports in literature predicting the rise of subspecialization in several specialties including urology. Discussions have focused on the many benefits this trend brings to patients in potentially reducing complication rates and improving outcomes, while minimizing costs.[3] There has been an increasing trend for community and general urologists to refer cases to academic centers, citing volume, experience, or financial factors as motivating factors for transfer of care.[1] In Germany, subspecialization within urology has led to the creation of the "office urologist" whose activity is restricted at the end of training to diagnosis and nonsurgical treatments, or a limited range of surgical treatments. This practice structure is also being explored in the United Kingdom.[4] There is a growing body of literature across several fields highlighting the positive aspects of this trend, by associating high caseload and subspecialization with various outcome measures.[5-7] Within urology, there is strong evidence that surgeons who perform more radical prostatectomies (RPs) tend to have fewer perioperative complications compared with those who perform fewer such procedures.[6]

In this study, we aim to elucidate the evolving practice patterns of individual urologists within inpatient urology over a 31-year period, spanning from 1982 to 2012. We show that there is a trend toward concentration of cases within a small group of urologists. We highlight 4 inpatient urologic procedures: partial nephrectomy (PN), radical nephrectomy (RN), RP, and radical cystectomy (RC), as procedures undergoing this shift.

METHODS

Database

This study used data from the Statewide Planning and Research Cooperative System (SPARCS) as well as from the American Medical Association (AMA) Physician Masterfile. The SPARCS dataset is a New York State database established in 1979, and compiled by the New York State Department of Health Office of Quality and Patient Safety. New York State law mandates the collection of certain data from all inpatient centers in the state of New York. The SPARCS database provides a unique opportunity

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From the Icahn School of Medicine at Mount Sinai, New York, NY; and the Department of Urology, Icahn School of Medicine at Mount Sinai, New York, NY

Address correspondence to: Michael Palese, M.D., Icahn School of Medicine at Mount Sinai, One Gustave Levy Place, Box 1272, New York, NY 10029. E-mail: Michael.Palese@mountsinai.org

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to examine inpatient physician trends due both to its completeness and the availability of a physician identifier that may then be linked to other resources. The AMA Physician Masterfile was established in 1906 and includes current and historical data for more than 1.4 million physicians, residents, and medical students in the United States.

The SPARCS database includes information on patient characteristics such as age, race, ethnicity, and gender. It also provides the principal procedure along with up to 14 secondary procedures for each encounter, using the "International Classification of Disease, Ninth Revision, Clinical Modification" (ICD-9-CM). Up to 3 physicians, listed as "operating," "attending," and "other" are identified for each encounter, enabling the identification of associated physicians. The AMA Physician Masterfile provides information of a physician's completed residencies, allowing verification of urology residency completion.

Study Sample

Prior to the commencement of this study, the study design was approved by the institutional review board of the Icahn School of Medicine at Mount Sinai. Using the SPARCS dataset, the study sample was collected for PN (ICD-9 55.4), RN (ICD-9 55.5), RP (ICD-9 60.5), and RC (ICD-9 57.71) over the study period of 1982 to 2012, identifying all encounters with a matching procedure code and a preadmission code indicating that the procedure was completed during the visit. Encounters involving patients below the age of 18 were removed to focus on adult urology. The physician state license numbers associated with each encounter were recorded. The completion of a urology residency program was verified using the AMA Physician Masterfile.

Identification of High-volume Urologists

Evolving technology and practices over the past 30 years preclude the ability to define a set number of cases to divide between high and low caseload inpatient urologists, as has been done in some studies.[8] Instead, we set about identifying the top 10% by caseload urologists for each of the procedures of interest for every year studied. After associating procedures with urologists, the urologists were sorted in ascending order by their total procedure volume. For every year, the physicians that were in the top 10% were identified and used in all subsequent consideration as high-volume physicians.

Key Variables of Interest

The outcome variables most relevant to this study were urologist caseload and the proportion of cases handled by high-volume physicians. The key independent variable is year. The average caseload per urologist was calculated along with the percentage of all cases in every year that the high-volume urologist group accounts for. The average case mix, defined as the distribution of the 4 procedures of interest among individual urologists, was determined for all urologists and for urologists identified as high volume for their respective year. This was done to better understand the practices of urologists involved in these procedures.

Statistical Analysis

Analysis was completed using the Python-based Pandas and Matplotlib packages and R (version 3.2.3). Initial data exploration and data extraction were completed utilizing a purpose-built program.[9] A linear regression was computed on 2 identified regimes (a period of increase followed by decrease separated by a maximum value) for a number of participating urologists to identify the rate of increase and decline of participation in each procedure over the period of interest. Linear regressions were also computed for a number of cases, the proportion of cases over a number of urologists, and the proportion of cases taken by high-volume inpatient urologists. A *t* test was ran for significance of all computed slopes. Chi-squared analyses were conducted to examine the relationship between case mixes in 1982 and 2012 as well as between case mixes of high-caseload urologists. After noticing a steady rise in RC cases that we could not find clear support for in the literature, we acquired publicly available bladder cancer incidence rate data from the National Cancer Institute's Surveillance, Epidemiology, and End Results Program as well as the United States (US) annual population data from the US Census Bureau to determine whether this rise could be explained by increase in population or bladder cancer incidence rate.

RESULTS

The total number of cases per year rose for all procedures over the period of interest (PN: 760%, RN: 25%, RP: 2636%, RC: 108%). Supplemental Figure S1 presents this increase over the period of interest. Linear regression of these data reveals a statistically significant rise for each procedure (PN: 53.5, $r^2 = 0.79$, $P < .001$; RN: 35.7, $r^2 = 0.76$, $P < .001$; RP: 180.0, $r^2 = 0.87$, $P < .001$; RC: 10.4, $r^2 = 0.92$, $P < .001$). Of this total, cases involving patients under 18 were not used in this study (PN: N = 1066, RN: N = 4226, RP: N = 42, RC: N = 29). Encounters in which a urologist, defined by the completion of a urology residency, could not be identified were also discarded (PN: N = 1643, RN: N = 20,051, RP: N = 4424, RC: N = 1153).

A total of 16,609 PN, 65,636 RN, 85,971 RP, 15,310 RC cases were used in this study. Table 1 provides univariate analysis of the demographic data of the study group for each procedure. Figure 1 charts the rise of cases for each procedure (PN: 52.0, $r^2 = 0.81$, $P < .001$; RN: 32.1, $r^2 = 0.75$, $P < .001$; RP: 171.9, $r^2 = 0.87$, $P < .001$; RC: 11.8, $r^2 = 0.90$, $P < .001$). Figure 1 presents the distribution of urologists involved in PN, RN, RP, and RC encounters over time, by year. Noteworthy are 2 regimes existing for every procedure; an increase to a maximum followed by decrease. The maximum for PN was reached in 2004, for RN and RP in 1999, and for RC in 1996. Linear regression led to statistically significant increase (PN: 6.4, $r^2 = 0.76$, $P < .001$; RN: 7.5, $r^2 = 0.85$, $P < .001$; RP: 28.0, $r^2 = 0.94$, $P < .001$; RC: 5.9, $r^2 = 0.80$, $P < .001$) followed by a statistically significant decrease (PN: –2.3, $r^2 = 0.14$, $P = .172$; RN: –18.3,