Fellowship and Subspecialization in Urology: An Analysis of Robotic-assisted Partial Nephrectomy

Olamide O. Omidele, Natan Davoudzadeh, and Michael Palese

OBJECTIVE To evaluate the impact of a urologic fellowship on physician case-volume and immediate patient outcomes, and to assess predictors of undergoing a robotic-assisted partial nephrectomy by a fellowship-trained (FT) urologist.

METHODS We retrospectively reviewed all robotic (ICD-9 17.4) partial nephrectomies (PN; ICD-9 55.4) reported in the Statewide Planning and Research Cooperative Systems (SPARCS) database of New York State (NYS) from 2009 to 2014. Perioperative outcomes assessed included length of stay, 30-day readmission rates, 90-day readmission rates, and complication rates. Pearson chi-square tests were used to compare categorical variables, and unpaired Student *t* tests were used to assess continuous variables.

RESULTS FT urologists performed 2199 (56%) RAPN during the study period, and nonfellowship trained (NFT) urologists completed 1700 (44%) RAPN. FT urologists performed more RAPN in teaching hospitals than NFT urologists (23% vs 7%). The average surgical volume per year for a FT urologist conducting RAPN was 9.6 ± 2.2 cases/y. NFT urologists had an average surgical volume of 7.2 ± 1.5 cases/y ($P = <.0001$). No significant difference was found in length of stay, 30- or 90-day readmission rate, or complication rate between the groups. RAPN conducted at teaching hospitals were more likely to be conducted by FT urologists. Patients who were self-payers were less likely to have a RAPN by FT urologists.

CONCLUSION There were no differences for RAPN perioperative outcomes between FT urologists and their NFT peers. FT urologists perform a higher case-volume of RAPN in NYS, and this trend is increasing. UROLOGY 130: 36–42, 2019. © 2019 Elsevier Inc.

During residency, physicians gain valuable hands-on training and enhance the medical knowledge that they have been exposed to prior to residency. Fellowships in surgical specialties and subspecialties are common with reports of over 70% of general surgery chief residents pursuing fellowship training.[1] Data from the American Urological Association census reports that over 40% of urologists pursue fellowship with almost 20% pursuing more than one.[2] There are many reasons for why urology residents may choose to pursue a particular fellowship upon completion of their residency. These may include particular interest in a particular subspecialty of urology, desire for more training to solidify skills, potential for better financial returns in income, interest in an academic career, etc.

Over the past decade, urology-related residencies in the United States have started to provide residents with significant exposure to robotic surgery as its usage becomes more prevalent in urological surgical practice. The benefits of robotic surgery are clear: tremor reduction, advanced visual display, and greater manual dexterity.[3] Robotic surgery has also been shown to be similar, and often better, to traditional open surgery in patient outcomes.[4,5] However, mastery of this technology is subject to a steep learning curve—requiring several cases for mastery.[6,7] Thus, some urologists elect to pursue a fellowship upon completing residency to increase their proficiency with this technology and enhance their skills to be able to perform a RAPN efficiently and safely.

There are limited data assessing the impact of fellowship training in Urology. Of these studies, no study investigates the impact of fellowship training on physician case-volume or immediate perioperative outcomes. Furthermore, none of these studies highlights multiyear trends on how fellowship training is evolving or assesses predictors of receiving care from a Fellowship-trained (FT) urologist. The present study was designed to evaluate the impact of a urologic fellowship, identify predictors of receiving care from a FT urologist, and inspect how fellowship trends have changed over time.

Disclosures: *None.*

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Submitted: January 16, 2019, accepted (with revisions): March 18, 2019

https://doi.org/10.1016/j.urology.2019.03.028
0090-4295

MATERIALS AND METHODS

The Statewide Planning and Research Cooperative Systems (SPARCS) database of New York State (NYS) was used to study inpatient records of patients who had undergone partial nephrectomy (PN; ICD-9 55.4) from January 1, 2009 to December 30, 2014. The database is an all-payer reporting system maintained by NYS Department of Health. Access to the SPARCS database was granted by NYS Department of Health following review of a research proposal. IRB approval was obtained by our Institutional Review Board (IRB).

All operating physicians were identified by their state license number in order to evaluate their fellowship training status. FT physicians were defined as those urologists with notable fellowships in one of the following 3 fellowships: minimally invasive surgery, urologic oncology, or advanced urological robotic and laparoscopic surgery. NFT physicians were defined as those urologists without record of completing a fellowship. There were 69 physicians in the FT group and 95 physicians in the NFT group.

Subsequently, the robotic modifier (ICD-9 17.4) was used to identify all RAPN cases in NYS during the study period. Patient level variables such as age, sex, race, residency zip code, and insurance status were assessed from deidentifiable patient codes. Hospital level variables included surgical volume, hospital volume, length of stay, and charge information. Comorbidities were classified using the "Enhanced" ICD-9 Charlson method to give the Charlson comorbidity index.[8] Primary outcomes were length of stay, 30-day readmission rates, 90-day readmission rates, and complication rates. In the multivariate analysis, we analyzed the effect of patient demographics and hospital factors on RAPN performed by FT urologists.

Categorical variables were reported as frequencies with their corresponding percentage, and continuous variables were reported as a mean with its respective standard deviation. Categorical variables and continuous variables were compared between cohorts using the Pearson chi-square tests and unpaired Student's *t* test, respectively. Statistical significance was set at a *P* value of less than .05. All statistical analyses were performed using SAS v 9.4 software (SAS Institute Inc., Cary, NC).

RESULTS

FT urologists performed 2199 (56%) RAPN during the study period, and NFT urologists completed 1700 (44%) RAPN (Table 1). There were no significant differences between the 2 groups for demographic variables such as age, gender, and median income, but significance was noted for patient race ($P < .0001$) and insurance status ($P = .003$). A total of 513 cases (23%) performed by FT urologists occurred in teaching hospitals compared to just 106 (6%) by NFT urologists. The average surgical volume per year for a FT urologist conducting RAPN was 9.6 ± 2.2 cases/y. NFT urologists had an average surgical volume of 7.2 ± 1.5 cases/y ($P < .0001$). RAPN procedures performed by FT urologists incurred higher hospital charges ($56,874.61 vs $40,892.73 $P < .0001$). There was no significant difference

Table 1. Comparison of demographic and perioperative outcomes

	Total RAPN Cases		
	Fellowship	Nonfellowship	*P* Value
	2199 (100%)	1700 (100%)	
Age	59.0 (SD 13.0)	59.2 (SD 13.0)	.6612
Gender			.8752
Male	1383 (63%)	1065 (63%)	
Female	816 (37%)	635 (37%)	
Race			**<.0001**
White	1380 (63%)	1455 (86%)	
Black	274 (12%)	118 (7%)	
Asian	41 (2%)	15 (1%)	
Other/unknown	504 (23%)	112 (7%)	
Average median income by zip code ($)	76012.25 (SD 22544.14)	76727.74 (SD 19194.76)	.320
Teaching hospital status	513 (23%)	106 (6%)	**<.0001**
Mean surgical volume	9.6 (SD 2.2)	7.2 (SD 1.5)	**<.0001**
CCI			.145
0	1484 (67%)	1100 (65%)	
1	495 (23%)	404 (24%)	
≥2	220 (10%)	196 (12%)	
Insurance status			**.0027**
Private	1487 (68%)	1065 (63%)	
Medicare	677 (31%)	588 (35%)	
Self-pay	21 (1%)	29 (2%)	
Mean total charges	56874.61 (40077.44)	40892.73 (SD 37593.17)	**<.0001**
Mean LOS	2.7 (SD 2.2)	2.9 (SD 5.9)	.2092
30-day readmission, no. (%)	2 (<1%)	3 (<1%)	.5014
90-day readmission, no. (%)	50 (2%)	29 (2%)	.1323
Total # of complications	223 (10%)	198 (12%)	.257
Cardiac complications, no. (%)	22 (1%)	10 (1%)	–
Respiratory complications, no. (%)	44 (2%)	40 (2%)	–
Misc. surgical complication, no. (%)	54 (2%)	44 (3%)	–
Hemorrhage complications, no. (%)	91 (4%)	94 (6%)	–
Other complications, no. (%)	12 (<1%)	10 (<1%)	–

CCI, Charlson comorbidity index, LOS, length of stay.
Statistical significance noted in bold.

Table 2. Multivariate regression predicting odds of RAPN performed by FT urologists

Risk Factor	Odds Ratio (95% CI)	*P* Value
Age		
<45 y	Referent	–
45-65 y	0.87 (0.70-1.09)	.2546
>65 y	0.92 (0.71-1.22)	.9379
Gender		
Male	Referent	–
Female	0.94 (0.81-1.09)	.3927
Race		
White	Referent	–
Black	2.79 (2.19-3.56)	.0922
Asian	2.36 (1.27-4.37)	.887
Other/unknown	4.09 (3.24-5.15)	**<.0001**
Insurance status		
Private	Referent	–
Medicare	0.89 (0.73-1.11)	.170
Self-pay	0.49 (0.27-0.90)	**.0352**
Teaching hospital status		
Teaching hospital	Referent	–
Nonteaching hospital	0.25 (0.20-0.32)	**<.0001**
CCI		
equal to 0	Referent	–
equal to 1	0.89 (0.76-1.05)	.6891
≥ 2	0.86 (0.68-1.07)	.390

CCI, Charlson comorbidity index

between groups for length of stay, 30-day readmission rates, 90-day readmission rates, or complication rates.

Race was a predictor of FT-conducted cases, with other or unknown race status (odds ratio [OR] 4.09; 95% confidence interval [CI], 3.24-5.15; $P < .0001$) exhibiting increased odds of a RAPN performed by a FT urologist (Table 2). Nonteaching hospital status (OR 0.25; 95% CI, 0.20-0.32, $P < .0001$) and self-payer patient status (OR 0.49; 95% CI, 0.27-0.90, $P = .035$) were associated with decreased odds of FT RAPN.

The number of FT physicians performing RAPN increased from 24 to 52 (Fig. 1). NFT physicians increased from 22 to 55. RAPN cases conducted by FT urologists showed a 3-fold increase from 112 to 346 cases while those of NFT urologist increased 2-fold from 112 to 346 cases (Supplementary Fig. 1). The average case-volume increased from 7.0 to 12.0 over the 6-year period for FT urologists compared to an increase from 5.1 to 6.3 for NFT urologists over the same period (Fig. 2).

DISCUSSION

Both career and financial benefits of specialization are cited reasons for pursuing fellowship training.[9,10] Other reasons for pursuing a fellowship may include career-oriented goals of furthering ones knowledge base, job-market positioning, or academic prestige. Though studies have shown that FT physicians are more likely to work in an academic setting and publish more papers, the extent to which the benefits of fellowship translate to improved surgical outcomes is unknown.[11,12] This study shows that, though FT urologists and NFT urologists have no differences in immediate perioperative outcomes of complication rate and readmission rates, FT urologists see a larger percentage of the RAPN case-volume in NYS.

The impact of fellowship training on surgical outcomes is a widely studied topic.[13,14] A study by Arbabi et al showed that surgeries conducted by FT trauma surgeons are associated with a decrease in patient mortality (OR 0.4, 95% CI 0.1-0.8) and length of stay.[15] On the other hand, Kohn et al reported no differences in mortality between centers with and without fellowship programs for gastrointestinal surgeons performing esophageal surgery.[16] Though the abovementioned studies failed to use matched cohorts for comorbidities and disease states, a major source of bias in reporting outcomes, they highlight the overall theme that the impact of fellowship on perioperative outcomes has not been well defined and additional studies on this subject should be encouraged.

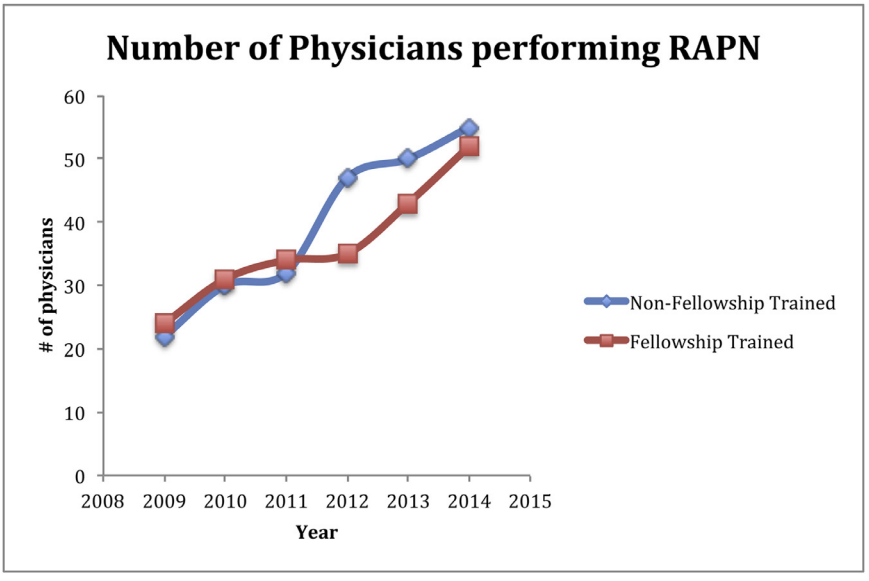

Figure 1. The number of physicians performing RAPN in NYS by FT urologists (minimally invasive, urologic oncology, and advanced laparoscopic and robotic) and NFT urologist from 2009 to 2014. (Color version available online.)

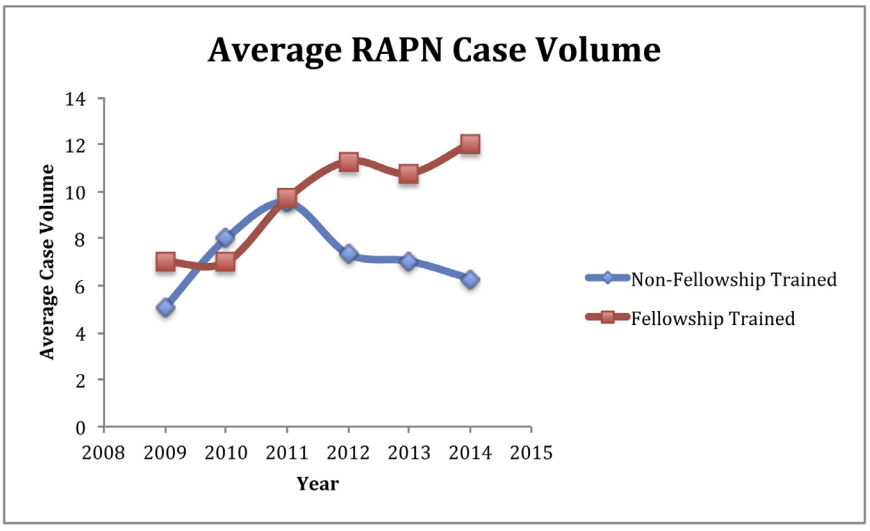

Figure 2. The average RAPN case volume per physician in NYS by FT urologists (minimally invasive, urologic oncology, and advanced laparoscopic and robotic) and NFT urologist from 2009 to 2014. (Color version available online.)

More specifically, the urologic literature lacks information on the impact of fellowship training on perioperative outcomes.[17-19] One study published by Nayak et al assessed the impact of fellowship training on pathologic outcomes following robotic prostatectomy.[17] They found that robotic prostatectomy performed by urologists with known completion of a urologic oncology fellowship had lower rates of positive surgical margins. Our study showed no disparities in perioperative outcomes between FT urologists and their colleagues. The most similar study to the current one is a study published by Trinh et al examining the impact of fellowship training on perioperative outcomes after radical prostatectomy. In this study, a higher percentage of patients treated at fellowship training hospitals had private insurance. We showed similar results with 68% of RAPN performed by FT urologists conducted on privately insured patients compared to just 63% of patients in the NFT group. Private insurance can be an indicator of socioeconomic class and health with reports showing wealthier and healthier patients making up a larger percentage of this cohort.[20,21]

Additionally, both the current study and Trinh's study show that fellowship training is associated with a higher case-volume. Trinh et al reported an average hospital volume for fellowship teaching hospitals of 365 compared to 57.6 and 121.0 for nonteaching hospitals and residency teaching hospitals, respectively. We report an average surgical volume for FT urologists of 9.6 ± 2.2 cases per year and 7.2 ± 1.5 cases per year for NFT urologists. The reason for this is multifactorial. Patients may be selecting physicians with more education and exposure with their procedure—believing that these surgeons will perform better. Another possibility is that NFT urologists may prefer to refer these procedures to physicians who have completed advanced specialization and may be more comfortable.

Both previously mentioned studies are not without limitations. Nayak's study solely looks at pathologic outcomes to assess the impact of fellowship training. Pathologic outcomes can demonstrate surgical ability, but they do not fully represent all of the outcomes that are important to consider. Our study examines perioperative outcomes such as length of stay, 30-day readmission rates, 90-day readmission rates, and complication rates. We believe these variables provide a more comprehensive assessment of surgical outcomes, as they measure not only surgical ability but also patient health. The main limitation in the Trinh study is associated with study design. They separate groups based on hospital level qualifications such as presence of residency training, presence of fellowship training, or lack of both. Though this provides information on how different types of hospitals fair, we believe it is more appropriate to compare surgeons and not hospitals in order to measure the impact of fellowship. In Trinh's study, a hospital that was labeled as a fellowship training hospital may have several urologists who did not complete fellowship performing surgeries. This definition introduces several confounders. Our study improves on this limitation by comparing surgeons not hospitals. Furthermore, we clearly define the fellowships we believe are most pertinent to RAPN proficiency—minimally invasive, urologic oncology, and advanced laparoscopic and robotic.

Our study showed a significant difference in charges between the 2 groups as FT physicians charged more for their services ($56,874.61 vs 40,892.73; $P < .0001$). We hypothesize that these differences may be linked to case severity and teaching hospital status. It is no secret that the more complex surgical cases are usually referred to large, teaching hospitals that are more able to manage patient care in the event of unforeseen complications. These complications and the overall complexity of these cases can significantly increase hospital charge. A study

from Chen et al assessing hospital teaching status and expenditures for hepato-pancreato-biliary surgery found similar results when they reported that hospital teaching status was associated with higher charges.[22] When they performed a more detailed analysis of this disparity, they found that the difference in charges between the 2 groups was linked to complication rates. Patients with complications (Δ = +70,067) had higher charges than patients without complications (Δ = +8,878; $P < .001$). This increase in charges in large volume hospitals has also been described in other literature and may be a reflection of billing practices.[23]

The major findings regarding RAPN trends in NYS include an increase in both the number of total cases and the number of total physicians performing this surgery over the study period. While the adoption of minimally invasive techniques in this study seems promising, it may not necessarily correlate with overall improvements in patient outcomes if physicians are replacing what would previously had been a laparoscopic partial nephrectomy (LPN) with a RAPN. Studies have shown that RAPN has improved perioperative outcomes when compared to radical nephrectomy or even open partial nephrectomy, but there is no clear consensus on the added benefits of the robotic approach compared to the standard laparoscopic approach when specifically analyzing patient outcomes.[24,25] Thus, it is important to elucidate whether the increased RAPN case-volume is arising from radical nephrectomy or LPN. If it is the later, additional studies are needed to clearly define the benefits of RAPN over LPN in relation to patient outcomes before one can summarize that this trend is undoubtedly favorable. Furthermore, the case-volume for both FT and NFT urologists increased from 7.0 to 12.0 and from 5.1 to 6.3, respectively. Though the average case-volume increased for NFT urologists over the study period, the trend-analysis shows a negative case-volume trend for this group in recent years. This may reflect pressures associated with cost, time-spent, and associated risk of performing a less familiar surgery. Overall, the trend suggests that RAPN are migrating toward academic or fellowship-trend surgeons who may better be able to navigate the aforementioned pressures.

The current study is not without limitations. Due to the nature of the database, we did not have access to clinical variables such as tumor size, tumor complexity, warm ischemic time, operative length, pathologic outcomes, and complication severity. Several studies on RAPN utilize these variables to measure outcomes, and they have become the benchmark variables to examine when considering operative outcomes associated with this procedure.[24,26,27] Without information pertaining to individual case complexity, it is impossible to know the extent to which patients in each group are comparable. Some may conceive that the more complex cases are being referred to academic centers with FT physicians as a result of both the individual surgical training and the nature of academic hospitals acting as referral centers for the more technically challenging cases. The phenomenon of large academic centers receiving the majority of complex surgical cases is not unique to the field of urology or even to NYS. It is happening on a national level and has been well reported in the literature.[28,29] Accordingly, this needs to be considered when evaluating the results of the current study, specifically in relation to our comparison between FT and NFT urologists' perioperative outcomes. We also recognize the limitations associated with a retrospective design. Specifically, physicians were self-identified as either FT or not—introducing a potentially significant bias related to determination of surgeon educational status. Last, our data have some generalizability but are specific to NYS. NYS is the third largest in terms of health care and is likely a microcosm for other state systems. Additional studies with national databases are needed to confirm the results in this study. Even with the limitations in the study, the data suggest an increase in the number of RAPN performed in NYS over the study period. Considering the documented benefits of this approach, this is an encouraging trend.

CONCLUSION

We report an increase in the number of RAPN performed in NYS. FT urologists are seeing a larger RAPN case-volume when compared to their NFT colleagues. Despite the limitations of the data, we were encouraged to find no difference in the immediate perioperative-reported complication and readmission rate.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.urology.2019.03.028.

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EDITORIAL COMMENT

Partial nephrectomy (PN) has gradually become the leading surgical treatment for small renal masses over the 2 decades, especially after the dissemination of the robotic platform.[1] Mastering this challenging surgical procedure requires structured training, and a steep learning curve.[2] The authors of this intriguing study used a state-wide database (SPARCS, New York State) to evaluate the impact of a urologic fellowship on physician case-volume and immediate outcomes of robotic-assisted PN (RAPN), and to assess predictors of undergoing a RAPN by a fellowship-trained urologist. Surgical training in the era of robotic surgery remains matter of debate, as US graduates of urology residency program still perceives lack of confidence in advanced minimally invasive procedures, such as RAPN.[3] Previous literature already showed an increasing ability of those surgeons who attended a mini-fellowships and courses.[4,5] Certainly, a structured fellowship program, such as those offered by the Endourological Society or the Society of Urologic Oncology, can potentially provide exposure to larger surgical volumes and to more complex cases so that the trainees can overcome the learning curve and fill deficiencies that he/she might have experienced during residency.

Few findings of the present study are worth mentioning. Fellowship-trained urologists performed slightly higher number (56% vs 44%) of the total number of procedures done in the 5-year study period (2009-2014), which is probably less than one would expect. Not surprisingly, RAPN done at teaching hospitals was more frequently done by fellowship-trained urologists (23% vs 7%). The average surgical volume per year was also slightly higher for those fellowship trained (9.6 cases vs 7.2 .5 cases), but what strikes the most is that on average those performing RAPN in the state of New York do less than 10 cases a year. In any case, the outcomes were comparable between RAPN done by fellowship trained and those without a fellowship. And these outcomes seem to mirror those of high volume centers.[1] Last, wealthier people were more likely to be treated by fellowship trained. Previous studies demonstrated that more educated and higher wage patients have higher odds to be treated with RAPN in tertiary level hospitals, which tend to be in larger cities.[6]

The main limitation of the present study (as many other based on administrative datasets) is the lack of granular information about tumor characteristics, and surgical data within SPARCS database. One can postulate that more complex cases were done in teaching/larger volume hospitals, and by fellowship-trained urologic surgeons. Notwithstanding these limitations, we would like to congratulate the authors for the present analysis, which can contribute to the ongoing debate, raising some critical points of discussion.

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UROLOGY 130: 41–42, 2019.

AUTHOR REPLY

We would like to thank both the editors and journal for giving us an opportunity to publish our work on the impact of fellowship training on physician case-volume and immediate perioperative outcomes in robotic-assisted partial nephrectomy (RAPN). Perhaps even more important than providing an assessment on the current landscape of urological fellowship training and its impact on both volume and outcomes, our report serves as a conversation starter to encourage urologists to think further about the utility of fellowship training as they plan out their careers. As more of our procedures move toward minimally invasive approaches, further exposure during a fellowship can be beneficial in helping a surgeon improve skills and garner confidence. However, this must be weighed against the potential financial loss by postponing training completion as well as one's personal preference on what type of practice they want to conduct.

There are 2 aspects of the study that we find noteworthy and wish to reemphasize. First, we report no observable differences in outcomes between urologists with fellowship and those without. Though encouraging, this may not tell the full story as the database lacked information on oncological outcomes and case complexity. Second, the average case-volume for fellowship-trained urologists performing RAPN is increasing over time while rates for those without fellowship are decreasing. We believe this trend is likely to continue due to factors such as patient preference and physician referral patterns to surgeons with additional training in these more complex procedures.

We encourage additional reports on the topic of subspecialization and fellowship training in the urological literature in order to help trainees make the most informed decision possible on whether or not to pursue a fellowship. It is important that, regardless of electing to pursue a fellowship or not, urology residents make a decision that fits their individual career goals.

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https://doi.org/10.1016/j.urology.2019.03.032
UROLOGY 130: 42, 2019.