Evaluation of Urology Residency Training and Perceived Resident Abilities in the United States

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OBJECTIVE: To identify differences and potential deficiencies in urology residency training programs in the United States as they are perceived by residents/recent graduates and program directors.

MATERIALS AND METHODS: A 45-question and 38-question survey was sent to chief residents/recent graduates and program directors, respectively, at all 120 US urology programs regarding prior medical education, urologic training curricula, and perceived surgical proficiency, among other topics.

RESULTS: Survey response rate was 58% and 52% for residents and program directors, respectively. Responses regarding program characteristics (e.g., salary, vacation) and research training were similar between program directors and residents. However, their responses regarding skills training and subspecialty training (e.g., robotics and pediatrics) differed substantially. Program directors reported the availability of advanced skills trainers (robot—88%, laparoscopic—86%), whereas fewer residents felt they were available (robot 54% and laparoscopic 72%). The same discrepancies persisted with questions about subspecialty exposure (e.g., program directors reported 48% renal transplant experience vs. 13% reported by residents). Most residents felt comfortable performing essential urology procedures (e.g., cystoscopy/ureteroscopy, open nephrectomy). In contrast, the majority expressed a lack of confidence in performing unsupervised advanced minimally invasive procedures (e.g., laparoscopic and robotic partial nephrectomy, endopyelotomy). Among the responding residents, 72% pursued fellowship training; nearly two-thirds of these residents chose to enter fellowship in order to overcome perceived training deficiencies.

CONCLUSIONS: Program directors and residents have differing perceptions regarding the education and resources associated with US urology residency training programs. US graduates of urology residency programs express a perceived lack of confidence in several procedures that are commonly encountered in a general urologic practice. (J Surg Ed 76:936–948. © 2019 Association of Program Directors in Surgery. Published by Elsevier Inc. All rights reserved.)

KEY WORDS: Medical education, Residency training, Internship, Residency curriculum, Urology residency, Fellowship

COMPETENCIES: Patient Care, Medical Knowledge, Professionalism

ABBREVIATIONS: American Council of Graduate Medical Education, ACGME, Next Accreditation System, NAS, Society of Urologic Chairpersons and Program Directors, SUCPD

INTRODUCTION

Due to the growing incidence and prevalence of a number of urologic diseases,[1] the demand for urologists is expected to rise.[2,3] Despite ongoing efforts to maintain and improve standards of urologic training, current training models do not meet clinical needs.[4] It is clear that standardized curricular elements have the potential to improve resident performance and benefit patients with urologic disease.[5] While core components of urology

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residency curricula have been proposed,[3,6] their universal acceptance and implementation have been limited.

Recent trends in graduate medical education reinforced the creation of standardized training programs. Beginning in 2001, the American Council of Graduate Medical Education (ACGME) made many changes to accreditation requirements to assure quality and consistency of graduate medical training across and within specialties. These include the 80-hour work week, the establishment of 6 core competencies and the introduction of the Next Accreditation System to establish specialty specific milestones and outcomes measurements.[7,8] While residency programs have shown commitment to meeting the changes set out by the ACGME,[9] a recent survey of Urology program directors demonstrated a number of barriers to the implementation of core competencies including inadequate validated instruments for evaluation, lack of required staff, and insufficient funding.[9] While some core competencies have been implemented well, others (i.e., practice-based learning) have not.[10] Moreover, faculty and residents have reported a discrepancy between surgical skills perceived to be important in the field and self-reported proficiency at those skills.[11] Indeed, there is room for improvement in resident education, ACGME competency measures, and in surgical skills training essential to urologic practice.[12,13]

We conducted a survey of US urology residents/recent graduates, and program directors to identify differences and deficiencies in urology training as reported by both groups. We also assessed perceived resident comfort level with numerous key urologic procedures.

MATERIAL AND METHODS

Survey Development

Institutional review board approval was obtained prior to the initiation of the study. The study was deemed exempt from participant informed consent, as the survey was anonymous and voluntary. The data collected for this study were kept in a deidentified database.

We developed a 45-item survey directed specifically to urology residents in their last year of training up to 5 years following graduation (henceforth referred to as "residents" (Appendix 1)), and a 36-item survey directed to program directors (Appendix 2). The anonymous surveys contained demographic inquiries followed by questions concerning preresidency and residency education, access to surgical skills laboratories, fellowship training, and subsequent planned urology practice. The surveys were similar except for the following: additional questions were asked to residents regarding their previous medical education and their self-assessment of surgical skill competency. Surveys included a combination of multiple choice and short-answer questions.

Data Acquisition

The anonymous survey was sent to all 120 urology residency training programs in the United States. Names and addresses of residency programs were obtained from the Society of Urologic Chairpersons and Program Directors. Residency program directors were requested to complete the program director-specific survey, and to assign one resident to complete the resident-specific survey. An introductory invitation letter including an explanation of the study's objectives and an assurance of confidentiality was included in both electronic and conventional mail formats. Second and third follow-up reminders with personal notes were sent to those who did not initially respond. The questionnaire was distributed using online survey software (SurveyMonkey Inc., Palo Alto, California; www.surveymonkey.com). Only 1 resident survey and 1 program director survey were accepted from each responding program.

Statistical Analysis

Written responses were qualitatively reviewed to identify trends and themes.

RESULTS

Resident and Program Director Responses

The overall response rate was 58% for chief residents and 52% for program directors. A summary of responses regarding residency program characteristics is reported in Table 1. All urology programs chose applicants via the Match process and required 1 or 2 years of general surgery training prior to urologic training.

Residents and program directors both reported that resident salaries are equal to or greater than $40,000 and all programs granted vacation time ranging from 15 to 30 days per year. Of note, 16% of residents reported having a second job outside of residency. All program directors reported that residents had duty hours capped at 80 hours, but 51% (N = 68) of residents reported working greater than 80 hours.

Didactic Education and Research Training

Time spent in didactic education activities (e.g., formal lectures) as reported by residents varied considerably from the hours reported by program directors (Table 1C). While there was a relative concordance between the resident and program director responses regarding research (Table 2) with both groups noting 89% participation; there was an absence of protected time to do the research as cited by 63% of the residents, but only 42% of the program directors. As expected, fewer residents from 5-year programs (53%) reported having protected time to do research vs. residents from 6-year programs (67%). All residents were required to

TABLE 1. Urology Residency Program Characteristics

(A) Training Length	Residents			Program Directors			p
	N	Count	%	N	Count	%	NS*
Length of general surgery training	61			59			
0.5 y		0			5	8	
1 y		43	70		48	81	
1.5 y		0			1	2	
2 y		16	26		5	8	
>2 y		2	3		0		
Length of urology-specific training	68			62			NS*
3 y		5	7		0	0	
4 y		37	54		50	81	
5 y		23	34		7	11	
6 y		2	3		5	8	
(B) Salary	68			22			<0.01
≤$39,999		4	6		1	5	
$40,000-$44,999		22	32		1	5	
$45,000-$49,999		8	12		7	32	
≥$50,000		34	50		13	59	
(C) Didactic education hours	Mean	Range		Mean	Range		
Grand Rounds	9.8	2-24		2.6	0.5-8		<0.01
Formal Lectures	9.8	0-40		3.5	0.5-12		<0.01
Training Courses	8.1	0-40		1.3	0-4		<0.01
Conferences	10.5	0.5-32		5.8	1-40		<0.01
Patient Rounds	29.3	1-150		14.5	0-60		<0.01

*NS, nonsignificant.

take an annual in-service exam to assess their learning and at the end of their "chief" year, the first part of the American Board of Urology certification examination.

Surgical Skills Training

Excluding renal transplant surgery, the majority of program directors reported that their programs expose residents to all areas of urology. Although residents concurred regarding exposure to general urology, endourology, and urologic oncology, considerably fewer residents reported exposure to other urologic subspecialties (Figure 1). Some remarkable deficiencies were found as only 13% (N = 67) of respondents reported being exposed to renal transplant, 60% (N = 67) to robotic surgery, and 78% (N = 67) to neurourology.

With regards to supervision in the operating room and office settings, 81% (N = 68) and 55% (N = 69) of residents, respectively, reported they were always supervised. In contradistinction, 100% and 92% (N = 60) of program directors reported constant supervision in those settings. Additionally, 81% (N = 68) of residents and 77% (N = 22) of program directors reported that the level of supervision decreased as their level of training increased.

A laboratory or training facility to practice several surgical skills was noted by 86% of the residents; these facilities varied with regard to the availability of simulators and training courses (Table 1). Despite the prevalence of these training facilities, 82% (N = 45) of residents and 67% (N = 58) of program directors reported that residents did not have protected time to spend in the skills laboratory.

Residents and recent graduates reported on their unsupervised procedural competency in a variety of procedures (Table 4). Regarding essential urologic procedures, over 95% reported feeling competent in performing cystoscopy, ureteroscopy, and transurethral resection of the prostate, varicocelectomy, scrotal/inguinal surgery, cystostomy, and transurethral resection of bladder tumor. However, less than 50% felt competent in performing percutaneous and laparoscopic procedures while barely one-third felt comfortable with robotic procedures. When data was stratified according to duration of the residency training (5 vs. 6 years), there was no difference in residents' perception of competency in performing minor, laparoscopic, and robotic procedures.

Regarding skills laboratory equipment, program directors reported that laparoscopic (86%), robotics (88%), and endourologic (44%) simulators were available for resident practice; however, the residents' response was much lower (72%, 54%, and 24%, respectively).

Postgraduate Fellowship Training and Entering the Workforce

Among the chief residents, 77% considered fellowship training and 72% actually entered fellowship

TABLE 2. Research and Clinical Training

	Residents			Program Directors		
	N	Count	%	N	Count	%
Didactic Education & Research Training						
Resident participation in research	66	59	89	62	62	100
Protected research time	59	22	37	62	29	47
Postgraduate Fellowship Training & Entering the Workforce						
Private Practice	53	15	28	62	39	63
Academic Practice	53	26	49	62	12	19
Fellowship	53	41	77	62	44	71
Clinical/Surgical Training						
Supervision						
Operating Room	68			61		
"Always"		55	81		61	100
"Sometimes"		12	18		0	0
"Never"		1	2		0	0
Outpatient Office	69			60		
"Always"		38	55		55	92
"Sometimes"		30	44		5	8
"Never"		1	1		0	0
Subspecialty exposure	67			61		
General Urology		67	100		61	100
Pediatric Urology		54	81		61	100
Endourology		66	99		61	100
Laparoscopy		59	88		61	100
Urologic Oncology		66	99		61	100
Robotics		40	60		60	98
Urogynecology		60	90		58	95
Reconstructive Urology		60	90		58	95
Neurourology		52	78		54	89
Andrology		55	82		53	87
Renal Transplant		9	13		29	48
Skills Laboratory Availability	63	54	86	61	59	97
Laparoscopy simulator	54	39	72	59	51	86
Robot simulator	54	29	54	59	52	88
Endourology simulator	54	13	24	59	26	44
Animal training course	54	21	39	59	27	46
Cadaver training course	54	12	22	59	18	31
Protected Time to Practice Skills	45	14	31	58	19	33

training (Table 3). Indeed, 71% of program directors noted that fellowship was the most frequently pursued career path following residency. The most common reason reported for choosing to pursue fellowship training was the perceived need for additional training in a specific field of urology.

With regards to clinical practice, 49% reported that they wanted to enter an academic practice; the

TABLE 3. Reasons for Postgraduate Training Decision

	Reasons	N	Count	%
Entered fellowship training	I felt the need for more skills training in a specific urology field	38	23	61
	I wanted to become an expert in a specific subspecialty of urology	38	12	32
	I entered fellowship due to colleague/job market/academic pressure	38	2	5
	I wanted further research training	38	1	3
Did not enter fellowship training	Felt no need to extend my urology training	15	4	27
	Wanted or needed to earn money	15	8	52
	Undecided	15	3	21

TABLE 4. List of surgical procedures and residents perceived proficiency

Surgical Procedures	Yes, Absolutely (%)	Yes, in Some Cases (%)	Not at All (%)
Procedures			
Adrenalectomy	19%	28%	53%
Cystoscopy	91%	4%	4%
Cystostomy	100%	0%	0%
Endopyelotomy	0%	13%	87%
Epispadias	3%	3%	94%
Hypospadias	16%	45%	39%
Incontinence (all procedures)	65%	35%	0%
Intestinal diversion	42%	37%	21%
Male penile reconstruction	26%	40%	35%
Orchiopexy	82%	7%	11%
Percutaneous renal procedures	48%	21%	31%
Renal transplant	19%	17%	64%
Scrotal/inguinal surgery	100%	0%	0%
Shockwave lithotripsy	72%	14%	14%
TRUS biopsy	84%	5%	11%
TUR bladder tumor	100%	0%	0%
TUR prostate	89%	9%	2%
Uretero(reno)scopy	100%	0%	0%
Ureteroscopy	87%	9%	4%
Urethral reconstruction	26%	44%	30%
Varicocoelectomy	75%	23%	2%
Open procedures			
Open cystectomy	45%	27%	27%
Open radical nephrectomy	64%	24%	12%
Open partial nephrectomy	51%	24%	24%
Open pyeloplasty	60%	19%	21%
Open radical prostatectomy	42%	23%	35%
Open retroperitoneal lymphadenectomy	28%	33%	40%
Open retroperitoneal surgery	22%	26%	52%
Open simple prostatectomy	59%	29%	12%
Laparoscopic procedures			
Laparoscopic retroperitoneal lymphadenectomy	3%	10%	88%
Laparoscopic cystectomy	2%	5%	93%
Laparoscopic radical nephrectomy	49%	22%	29%
Laparoscopic partial nephrectomy	16%	16%	68%
Laparoscopic pyeloplasty	32%	21%	47%
Laparoscopic radical prostatectomy	0%	9%	91%
Laparoscopic retroperitoneal surgery	5%	10%	85%
Laparoscopic simple prostatectomy	0%	8%	92%
Robotic procedures			
Robotic cystectomy	10%	12%	79%
Robotic radical nephrectomy	34%	7%	59%
Robotic partial nephrectomy	23%	14%	64%
Robotic pyeloplasty	28%	12%	60%
Robotic radical prostatectomy	27%	11%	61%
Robotic retroperitoneal lymphadenectomy	5%	7%	88%
Robotic retroperitoneal surgery	13%	0%	88%
Robotic simple prostatectomy	8%	92%	0%

remainder planned to go into private practice (28%), a health maintenance organization practice (9%), the Veterans Administration (17%), or research (6%). The majority (60%) planned to practice general urology. Of interest, the program directors noted that private practice (63%) was the most common planned route after residency or fellowship training with only 19% entering an academic practice. When we compared resident responses between those with 1 vs. 2-year general surgery there was no difference in terms of fellowship entrance. In this study, 66% residents graduating from a 5-year urology residency program and 87% residents graduating from a 6-year urology program have entered or plan to enter fellowship training.

DISCUSSION

Work Hour Regulations

The current study indicates several similarities among the responses of US urology residents and program directors with regard to program duration, research, and basic program characteristics including vacation time, salary, and work-hours restrictions. However, the survey noted marked inconsistencies in resident and program director responses in particular with regard to the 80-hour work week in which half of residents reported working more than 80 hours per week, while all program directors reported a maximum of 80 work hours per week.

The 80-hour work week is an important part of the ACGME's efforts in improving quality of care and quality of life among residents, although neither has been well documented to date. This current survey shows that while every program has adopted the work hour restrictions as policy, the policy is not necessarily followed by the residents. There has been much criticism regarding duty hour restrictions in surgical training, citing concerns such as reduced continuity of care,[14] and worsened resident education. A recent study examined the ACGME duty hour restrictions in surgical training and conducted a trial of flexibility in duty hour policies.[15] Interestingly, in the flexible duty hour group (i.e., the group exempt from duty hour restrictions that impact continuity of care) they found several benefits in regards to patient safety, continuity of care and surgical training. Flexible duty hours did, however, come at the price of resident quality-of-life and certain aspects of well-being.

The flaw in all of this is the original development of the residency 80-hour work week for all residency program regardless of whether they are purely cognitive or have both a cognitive and manipulative component. If indeed one needs an 80-hour work week to teach a 100% cognitive specialty in medicine or radiology; then there is a problem for the surgical specialties in which there is a similarly substantial cognitive component in addition to a 25% manipulative component. It is the authors' opinion that for surgical disciplines the work hour limit should be a more realistic 90-hour work week in which case compliance would be higher and the need for fellowship training possibly lower.

Didactic Education and Research Training

Most urology residency programs are 5 years in duration, including time spent rotating through general surgery, with the ACGME requiring a minimum of 48 months of clinical urology training.[16] Residents receive a considerable amount of didactic education in the form of grand rounds, lectures, conferences, and patient rounds. Residents perceived their time spent in these activities to be remarkably greater than time reported by program directors, and it is unclear why this discrepancy exists. Nevertheless, these formal educational forums represent a valuable opportunity for standardization and may serve as an effective forum for directed learning.[5]

Scholarly activity is another area of resident education that can be standardized, and one that may foster a desire to enter fellowship training or pursue an academic career.[17] Indeed, a recent study showed that graduates from 6-year programs with dedicated research time were more likely to pursue postgraduate fellowship training.[18] Additionally, residents who are given protected research time of 6 months or more have significantly increased academic productivity, and this productivity correlates with future fellowship training and academic careers.[18-20] Sadly, at the time of our questionnaire, only about a fifth of urology residency programs were still offering dedicated research time.[17,18] The ravages of decreasing reimbursement, increasing costs for infrastructure, new regulations for training, and reduction in work hours have all combined to reduce the amount of discretionary funds throughout all urology training programs such that few programs still have the funds necessary to allow a resident the luxury of a year or even 6 months in a laboratory setting. Indeed, the cost of such a program is usually in the range of $100,000/year per resident. Short of major philanthropy, this sad trend is likely not to reverse itself any time soon. It is clinical experience that often results in the asking of major research questions. Who better to answer those questions than the practitioners of the specialty that have had the opportunity to learn research techniques? By the same token, can a specialty maintain itself and flourish, if these questions are no longer being asked and pursued?

As a key aspect of resident training, a thoughtful integration of dedicated research time and training should be considered. The length of residency is relevant to applicants when creating a match rank list. Indeed, Peyton and Badlani reported that 67% of respondents in their study preferred 5-year programs with integrated research and busier clinic schedules to 6-year programs due to the burden of an extra year's training.[21] They reported that only 6.5% expressed no interest in research. However, the concept that one can eliminate the 6th year dedicated to research and somehow incorporate it into the 5 years dedicated to Urology while also providing the applicants' desire for a busier clinical schedule while adhering to an 80-hour work week is an irresolvable academic catch 22.

Surgical Skills Training

The landscape of urologic training is undergoing significant changes. Adoption of new technologies in minimally invasive surgery has contributed to the dramatic broadening of knowledge and spectrum of skills that residents must acquire during their training. As such, exposure to the entire spectrum of fields within urology is imperative in a urology residency. We discovered discrepancies between subspecialty exposure reported by program directors and residents. These perceived (or real) deficiencies in training are concerning.

This perceived or real lack of training is clearly corroborated by reviewing residents' comfort levels with performing various urological procedures. While chief residents were particularly comfortable with performing common office procedures (e.g., cystoscopy) and simple general urology procedures (e.g., TURP), they reported a notable lack of confidence with advanced, minimally invasive laparoscopic and robotic procedures. This lack of confidence is not unique to urologic surgical training, but in fact reflects a broader problem in surgical training overall as residency programs are challenged to teach an ever-advancing technological skill set.[4,22] In previous years, the majority of laparoscopic surgeries were being performed by fellowship-trained urologists,[23,24] and urologists are more likely to offer laparoscopic management if they have been trained in laparoscopy during residency.[25] It follows that laparoscopic procedures are therefore more likely to be performed in academic rather than community settings.[26] However, an emphasis on acquiring advanced skill in minimally invasive surgical technique is essential in changing practice patterns in all clinical settings. Again, it is likely that the constraints of a 5-year program instead of 6 years and the mandatory 80-hour work week have combined to significantly reduce the ability to acquire advanced surgical skills.

Laboratory-based skills training are an essential educational tool in surgery as simulators offer an important training opportunity that transfers to clinical skills.[6,27,28] Nearly all residency programs report being equipped with surgical training facilities that employ a variety of laparoscopic and robotic simulators. However, there was a remarkable discrepancy between resident and program director perceptions regarding the availability of these training models. Perhaps there is a lack of resident awareness of the simulation laboratory or the lack of protected simulation training time may be translated by the resident as making the facility "virtually" nonexistent. To be sure the development of "protected" laboratory training time is an important area of residency training that can be addressed through curriculum standardization and change; however, the time for this commitment would have to come at the sacrifice of clinical or research experience given the current limitations of the 80-hour work week.

The Next Accreditation System was implemented by ACGME in 2013 with the intention of standardizing a set of core curricular elements and urology specific milestones for all accredited urology-training programs. However, it was also built with the intention of facilitating innovation in education.[8] Our findings suggest that there is a need for improvement in surgical skills training to increase resident confidence and competency. Many creative, cost effective methods have been suggested and implemented successfully on the small scale, such as gamification to motivate practice time,[29] crowdsourcing for skills feedback,[30] and flexible tracks during residencies. A continued emphasis on the implementation of creative improvements in surgical skills training is essential to determining how surgical training can maintain pace with innovation. However, in this as in all things, there are no short cuts to excellence and the attainment of advanced surgical skills requires both training laboratory experience as well as actual hands-on operating room experience. Again, the resident's ability to learn these manipulative skills conflicts on a daily basis with the mandated 80-hour work week regulations. Until these regulations are altered for the surgical disciplines, the authors see little hope in improving the current state of affairs. In essence the reduction of the typical 90-hour/week, 6-year program into an 80-hour/week 5-year program has mandated the majority of graduating residents who are seeking to attain skills beyond that of simple office level procedures to go into a 1- or 2-year fellowship program during which time there are no limitations on the hours they can spend learning their craft.

Postgraduate Fellowship Training and Career Choices

Over the past 2 decades, the number of accredited fellowship programs has significantly expanded with emphasis on highly specialized and advanced training. A goal of resident education is to prepare the resident physician/surgeon for independent practice upon graduation, however in our findings an alarming number of chief residents report feeling inadequately prepared to perform major or complex urologic surgeries independently. Not surprisingly, over 60% of residents pursued fellowship training specifically due to a perceived need for additional skills training. A similar observation was also noted several years ago, and it was believed that insufficient operative experience was the impetus to pursue fellowship training.[17] Surprisingly, the desire to gain subspecialty skills was a secondary motivation. This is a marked deviation from prior surveys in which only half of those pursuing fellowship sought to gain more

experience, citing intellectual appeal, mentorship, achieving marketability, and facilitating a career in academics as their motivation.

In regards to chief residents' perceived lack of competence in more complex or more technically demanding procedures, there are likely several underlying reasons as noted throughout this discussion. First, while almost all programs have surgical skills training laboratories, there is very limited, if any, time allocated for residents to use the laparoscopic and robotic skills laboratory. Second, there is limited time to acquire these manipulative skills given the 80-hour work week. Third the training programs themselves have been further reduced with the vast majority now only being 5 years; 6-year programs afforded residents a laboratory experience which for many included exposure to animal surgery and perfection of surgical techniques. Fourth, residents may subconsciously not be concerned about this lack of competence given that nearly three-fourths are planning to take a 1 to 2-year fellowship during which time they have no limitations on their work hours.

As with all questionnaire-based studies, there are numerous areas of concern. First, the study is based on self-reported questionnaires. We did not audit any of the responses nor was there a method in place to confirm the accuracy of responses. Second, a more robust data set, with a larger sample size, would have been desirable. Despite several requests by the junior and then senior authors, we were only able to achieve a 50% response rate. While disappointing, it is of note that our response rate of just over 50% is approximately 10% higher than other studies of a similar nature. Next, both the resident and program director questionnaires were sent to the program director at a given institution in order to simplify distribution. The program director was given the flexibility to choose a resident or recent graduate (i.e., $\leq$5 years after graduation) to complete the questionnaire; this certainly could have introduced a selection bias, albeit in favor of the program. Although our survey results demonstrated that the residents had limited access to the robotic assisted procedures, it is not clear whether this was due to a limited number of cases performed at their institution or due to having limited console time despite having sufficient surgical volume. Another cause may be the presence of a clinical fellow who might negatively impact the resident's experience. The only way to determine these factors would be to delve into the case logs of both residents and fellows; however these data were beyond the abilities of our study.

CONCLUSIONS

Program directors and residents have differing perceptions regarding the education and resources associated with US urology residency training programs. Current US graduates of urology residency programs express a perceived lack of confidence in several major/more complex procedures that are commonly encountered in a general urologic practice; accordingly, almost three-fourths of US graduates are now pursuing postgraduate fellowship training.

AUTHOR CONTRIBUTIONS

Dr. Landman and Dr. Okhunov had full access to all study data and take responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Juncal, McDougall, Landman.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Okhunov, Safiullah, Landman, Clayman.

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SUPPLEMENTARY INFORMATION

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.jsurg.2019.02.002.

APPENDIX 1. RESIDENT QUESTIONNAIRE

Urologic Training in the United States: Survey

Please complete the survey below.

1 Were you required to complete an undergraduate/premedical training/degree before medical school? a. Yes b. No
2 In what year did you complete medical school? _____
3 What was the duration of your medical school training? _____
4 Please write the name of the medical school you attended: _____
5 In what year did/will you complete your urology training? _____
6 Is your urology training program certified and accredited by the ACGME? a. Yes b. No
7 Were you required to take an exam to assess your urology training? a. Yes b. No
8 If yes to the previous question, how often? _____
9 If yes to the previous question, who was responsible for setting this exam? _____
10 Were you required to achieve a predetermined score on the tests to pass the test? a. Yes b. No
11 After your urology training program, do/did you need to take an exam set by a credentialing board? a. Yes b. No
12 Have you been abroad for any part of your residency training? a. Yes b. No
13 Did you choose/Are you choosing to pursue fellowship training? a. Yes b. No
14 Please write the name and location of your fellowship training, if applicable: _____
15 What field is/was your fellowship training in? _____
16 Please indicate the reason why you choose to pursue fellowship training or not:
- Did not enter fellowship training, as felt no need to extend my urology training
- Did not enter fellowship training, because I wanted/needed to earn money
- Entered fellowship training because I felt need for more training skills in a specific urology field
- Entered fellowship training due to excitement about becoming an expert in a specific subspecialty of urology
- Entered fellowship training because I wanted further research training
- Entered fellowship training because of colleague, market, job, academic pressure.
- Did not enter fellowship training, as the country where I practice has few, or no, fellowship training programs, but I wish I could have extended my urology training
- Undecided

17 Did you need to complete an internship to acquire a full medical license? a. Yes b. No
18 If yes to the previous question, is internship completed during medical school? a. Yes b. No
19 How long was the internship (in years)? _____
20 Did you undergo general surgery training prior to urology training? a. Yes b. No
21 Was this part of your urology residency program or separate internship? a. Yes b. Separate
22 How long was your general surgery training (in years)? _____
23 How long is the current standard urology residency training (excluding general surgery years)? ___
24 What was the selection system to enter your urology residency program? a. Interview only b. Match only c. Interview + Match
25 Does your program have a maximum number of work hours per week?
a. Yes b. Yes, but not respected c. No
- Please specify maximum work hours, even if not respected: _____

26 Did you receive a salary during your urology training? a. Yes b. No
27 If you received a salary, please select your salary range:
$10,000-$14,999 $15,000-$19,999 $20,000-$24,999 $25,000-$29,999 $30,000-$34,999 $35,000-$39,999 $40,000-$44,999 $45,000-$49,999 ≥ $50,000
28 Do/did you have another job or any type of work activity to supplement your resident's salary during your free time? a. Yes b. No
29 Are/were you entitled to a vacation during your urology training? a. Yes b. No a. If yes, how many days per year (even if not respected)?
30 Which subspecialties are/were you exposed to during your urology training? (check all that apply)
- General Urology - Pediatric Urology - Endourology - Laparoscopy - Robotic Surgery
- Oncology - Neurourology - Andrology - Reconstructive urology
- Female urology - Renal transplant

31 Are/were you supervised by faculty during clinic / ambulatory care of patients? a. Always b. Never c. Sometimes
32 Are/were you supervised by faculty during operative procedures? a. Always b. Never c. Sometimes
33 Does/did intensity of supervision decrease as your level of training increased (i.e. Junior → Senior → Chief Resident) or does/did it remain the same? a. Increased b. Decreased c. Remained the same
34 Please check in the box the approximate total number of cases you have performed as primary surgeon (present for and performing all the critical steps of the case) during your residency, for each of following surgical procedures.
35 After completing residency, did or do you feel capable of performing the following procedures as first surgeon/ unsupervised? a. No, not at all b. Yes, in some cases c. Yes, absolutely
[Open/Laparoscopic/Robotic]: Cystectomy; Nephrectomy; Partial Nephrectomy; Pyeloplasty; Radical Prostatectomy; Simple Prostatectomy; Retroperitoneal
Lymphadenectomy; Retroperitoneal surgery
Other: Cystoscopy; Cystostomy; Adrenalectomy; Endopyelotomy; Epispadias; Hypospadias; Incontinence (all procedure); Intestinal diversion; Orchiopexy; Penile reconstruction; Percutaneous renal procedures; Renal transplant; Scrotal/Inguinal Surgery; Shockwave Lithotripsy; TRUS biopsy; TUR Bladder Tumor; TUR Prostate; Uretero(reno) scopy; Ureteroscopy; Urethral reconstruction; Varicocelectomy
36 Do/did you participate in research during your urology training? a. Yes b. No
37 If yes, are or were the research activities a formal time within your urology training hours? a. Yes b. No
38 If the following education activities are or were part of your urology training, please type the estimated number of hours per month for each activity in the box provided.
- Grand Rounds - Lectures - Training courses - Conferences - Patient Rounds
39 Does or did your program have a laboratory or training facility where you could practice open surgery, laparoscopy and/or robotic skills? a. Yes b. No
40 If yes, do or did you have a specific time during your urology training hours to practice in the lab or was this outside regular hours?
- Formal time - Outside work hours - Not applicable
41 What equipment/courses are or were available for these surgical skills training? (check all that apply)
- Laparoscopic simulator - Robotic simulator - Endourologic simulator
- Animal training courses - Cadaver training courses
42 Please specify the number of hours per week or month dedicated to the courses, and how often the courses occurred: _____
43 Please check all types of extracurricular activities (activities performed by residents that fall outside of the real; of the normal curriculum as determined by your urology training program) that you participated in during your urology training program.
- National courses - International courses - National meetings - International meetings
- National exchange programs - International exchange programs
44 Do you [want to] work in a specific urologic area/subspecialty or in general urology?
45 What type of practice do you [want to] work in?
- Academic - Research - Private practice
- Health maintenance organization - Government

APPENDIX 2. PROGRAM DIRECTOR QUESTIONNAIRE

Urologic Training in the United States: Survey

Please complete the survey below.

1 Please specify in which country and Hospital/ University you function as the Urology Training Program Director: _____

2 How long have you been the Urology program director? _____

3 How long is your urology training program, without counting previous internship or general surgery training (in years)? _____

4 Does the urology training program require general surgery training? a. Yes b. No

5 If yes, how long is the required general surgery training for your program (in years)? _____

6 How does your program select the residents to enter the urology training program? Mark all that apply.
Interview only b. Match only c. Interview + Match

7 Is your urology training program certified and accredited by society/association/committee? a. Yes b. No

8 What is the name of the society/association/committee? _____

9 Does the society/association/committee have standard rules, guidelines and recommendations that must be followed by all training urology programs around the country? a. Yes b. No

10 Does the society/association/committee periodically review your urology training program all facilities and requirements for the training are met? a. Yes b. No

11 Which of the following urology subspecialties are included in your urology training program? (Mark all that apply)
General Urology - Pediatric Urology - Endourology - Laparoscopy - Robotic Surgery
- Oncology - Neurourology - Andrology - Reconstructive urology
- Female urology - Renal transplant

12 Are the residents supervised by a faculty during their care of clinic / ambulatory patients?
Always b. Never c. Sometimes

13 Are the residents supervised by a faculty during their operative procedures?
Always b. Never c. Sometimes

14 Does intensity of supervision decrease as the resident level of training increases (i.e. Junior → Senior → Chief Resident) or remains the same?
Increased b. Decreased c. Remained the same

15 Do residents receive a salary during their urology training? a. Yes b. No

16 What is the range of salary (USD per year) for residents in your program?
$10,000-$14,999 $15,000-$19,999 $20,000-$24,999 $25,000-$29,999 $30,000-$34,999 $35,000-$39,999 $40,000-$44,999 $45,000-$49,999 ≥ $50,000

17 Do the residents have a maximum number of work hours per week? a. Yes b. No

18 Please specify the work hours per week: _____

19 Who is responsible for supervising the work hour restrictions? _____

20 Are the residents entitled to vacation time during their urology training? a. Yes b. No

21 How many days of vacation are given per year? _____

22 Do the residents participate in research activities during their urology training? a. Yes b. No

23 If yes, are the research activities a formal time within the urology training hours or outside regular hours?
Formal time - Outside work hours - Not applicable

24 If residents do participate in research, please specify the average hours spent per month in research activities, and the number of months during the entire residency program. _____

25 If the following education activities are part of your urology training program, please write the estimated number of hours per month for each activity.
Grand Rounds - Lectures - Training courses - Conferences - Patient Rounds

26 Does your residency provide access to a surgical skills laboratory? a. Yes b. No

27 If yes, what equipment / courses are available for skills training? (Check all that apply)
Laparoscopic simulator - Robotic simulator - Endourologic simulator
Animal training courses - Cadaver training courses

28 If yes, do the residents have protected time during urology training hours to practice in the lab or are they required to do so outside regular hours?
Formal time - Outside work hours - Not applicable

29 Please select each box the surgeries the residents perform during your urology residency training program as the surgeon, present for all of the critical steps of the case and perform a significant number of the critical steps of the procedures, and/or as the first assistant.
[Open/Laparoscopic/Robotic]: Cystectomy; Nephrectomy; Partial Nephrectomy; Pyeloplasty; Radical Prostatectomy; Simple Prostatectomy; Retroperitoneal Lymphadenectomy; Retroperitoneal surgery
Other: Adrenalectomy; Endopyelotomy; Intestinal diversion; Penile reconstruction; Percutaneous renal procedures; Renal transplant; Scrotal/Inguinal Surgery; Shockwave Lithotripsy; TUR Bladder Tumor; TUR Prostate; Ureteroscopy; Urethral reconstruction

30 Are the residents required to perform as the surgeon or first assistant a minimum amount of each type of urologic surgery in order to complete the urology training program? a. Yes b. No

31 Are the residents required to take any tests during their training program to measure their urology learning? a. Yes b. No

32 If yes, how often are the tests taken? _____

33 If yes, who sets and administers the exam? _____

34 Are the residents required to achieve a certain score on these tests during their training? _____

35 Following completion of the urology training program, are the residents required to take examinations set by a certifying board? a. Yes b. No

36 From observing your previous resident trainees, please indicate the subspecialty training or practice-type most of them undertake following their training program?
- Academic - Research - Private practice - Public practice/Government