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The implications of fellowship expansion on future pediatric urologist surgical volumes

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Summary

Introduction
Over the past 25 years, Pediatric Urology fellowship programs accredited by the Accreditation Council for Graduate Medical Education (ACGME) have more than doubled. This increase may lead to a significant decrease in the number of operative cases per surgeon and therefore impact the current practice of pediatric urology.

Objective
The objective in conducting this study is to try and predict the effect of the current number of pediatric urology fellowship training positions on future case volume per surgeon using a mathematical model and to discuss future management of the pediatric urology workforce.

Design
The current study employed a mathematical model to predict the effect of the number of fellowship graduates on future "case volume per surgeon". We incorporated population growth rates, to calculate incidence rates of key procedures/conditions and the anticipated retirement rate of the current pool of pediatric urologists to help calculate this.

Results
There is a possibility to increase the number of practicing board-certified pediatric urologists in the next 30 years from approximately 325 to 900 (figure). There will be a twofold reduction in case volume per surgeon compared to the present in model 1. In model 2 the decrease in case volumes is less significant. The annual number of fellows needed to obtain a future-to-current ratio equal to 1 is 16 for model 1, and 26 for model 2.

Discussion
Our study demonstrates, by using two different models that the current number of pediatric urology fellowship training positions in the United States will ultimately lead to a significant decrease in the case volume per surgeons. Our model has limitations as it relies on multiple assumptions. We are assuming that all fellowship positions would be filled every year and that all fellows would graduate, establish their practices in the United States, and devote 100% of their assumed 30-year professional career to pediatric urology. We also made assumptions of disease occurrence and need for surgical correction. The final assumption we made was that the birth rate would stay static over the next 30 years even though it has been declining for many decades.

Conclusion
This exercise, even with its inherent limitations, is still sufficient to demonstrate that fellowship expansion warrants thoughtful discussion.

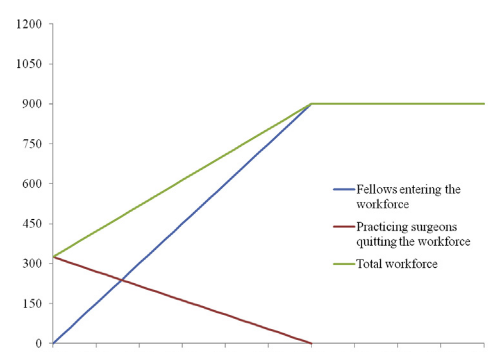

Figure The projected changes in pediatric urology manpower, eventually leading to a steady-state of 900 pediatric urologists in 30 years, a point where the number of retiring pediatric urologists will be replaced by an equivalent number of fellowship graduates on an annual basis.

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Introduction

Over the past 25 years, Pediatric Urology fellowship programs accredited by the Accreditation Council for Graduate Medical Education (ACGME) have more than doubled [1]. As a result, an increasing number of graduates are now eligible for certification of added qualification in pediatric urology by the American Board of Urology (ABU). This expansion has potential benefits and risks. This increase may lead to a significant decrease in the number of operative cases per surgeon and therefore impact the current practice of pediatric urology.

There is an ongoing debate whether this increase in pediatric urology manpower in the United States is needed and appropriate. In addition, others have questioned if this increase will lead to a significant decrease in the number of operative cases per surgeon and therefore impact the current practice of pediatric urology. Because of the well-documented correlation to case volume and surgical outcomes, it is imperative to try and assess the effects of fellowship expansion [2–9].

The current study employed a mathematical model (manpower equation) to predict the effect of the number of fellowship graduates on future "case volume per surgeon". We incorporated population growth rates, to calculate incidence rates of key procedures/conditions and the anticipated retirement rate of the current pool of pediatric urologists to help calculate this. In addition to pediatric urologists, the supply side of the manpower equation also includes a significant number of adult urologists and pediatric general surgeons that manage pediatric urology patients as part of their practice and must be accounted for.

On the other side of the equation, the demand is affected by the national birth rate, changing disease incidence rates, changing referral patterns, and changing management protocols for certain diseases.

Our objective in conducting this study is to try and predict the effect of the current number of pediatric urology fellowship training positions on future case volume per surgeon using a mathematical model previously developed at the Medical College of Wisconsin [10] and to discuss future management of the pediatric urology workforce.

Methods

This study did not include any patient data or information and was a mathematical study using previous published disease rates and incidence making it IRB exempt.

The current number of accredited pediatric urology fellowship programs and annual number of training positions for each program were obtained from the Society of Pediatric Urology (SPU) [1]. Certain assumptions were made for our model in both the supply and demand side. We assumed that all fellowship-training positions would be occupied every year and that all graduates would practice for 30 years within the United States after completion of their fellowship. An estimate of the current pediatric urology manpower was calculated by the total number of candidates that have passed the pediatric subspecialty certificate examination (PSCE) from the ABU [11]. We calculated a yearly retirement rate of 3.33% based on an assumed 30-year professional career. The future full-time pediatric urology workforce was calculated for every year from 2014 to 2043 by adding the number of new graduates to the number of practicing pediatric urologists and subtracted the number lost to retirement.

Five pediatric urology conditions were chosen as index cases: undescended testis, hypospadias, ureteropelvic junction obstruction, posterior urethral valve, and neurogenic bladder secondary to spina bifida. A literature search was performed to find the current incidence of these conditions and estimates of the current annual number of surgeries performed for each of these conditions (orchiopexy, hypospadias repair, pyeloplasty, posterior urethral valve ablation, and bladder augmentation, respectively). Future numbers of cases for the years 2014–2043 were estimated by adjusting current numbers for the 2013 US birth rate.

Case volume per surgeon for each of the five index cases was calculated by dividing the predicted annual number of cases for each specific year by the corresponding number of pediatric urologists according to our manpower estimation; case volume per surgeon was then adjusted according to two models. Model 1 assumed that the current distribution of cases between board-certified pediatric urologists and other surgeons would continue and that pediatric urologists would only perform a fraction of the available surgeries for the five index cases. The remaining surgeries would be performed by adult urologists and pediatric general surgeons. The proportion of cases to be performed by pediatric urologists was estimated to be 0.5, 0.8, 0.8, 0.6, and 0.7 for orchiopexy, hypospadias repair, pyeloplasty, posterior urethral valve ablation, and bladder augmentation, respectively. Model 2 assumed that 100% of available surgeries for the index cases would eventually be performed by board-certified pediatric urologists. In the interval between 2014 and 2043, the percentage of cases performed by pediatric urologists is assumed to increase annually at a fixed rate of 3.33% until it reaches 100% at 30 years.

Table 1 lists all of the model variables and their chosen values.

Results

The ABU first started awarding certification of added qualification in pediatric urology in 2008. This allowed us to make the assumption that all current pediatric urologists in the current workforce, no matter when they had graduated, were certified in 2008. The ABU has awarded this certification of added qualification to a total 325 candidates from 2008 to 2014. Those graduates represent the current pediatric urology workforce. There are presently 29 SPU-accredited fellowship programs available with the potential to graduate 30 fellowship trained physicians yearly with the assumption that all fellowship positions fill there will be an addition of 900 board-certified pediatric urologists to the workforce over the next 30 years. If we also make the assumption that the average career will be 30 years we can make the premise that the yearly retirement rate is 3.33%. All the currently practicing pediatric urologists will have left the workforce in 30 years allowing us to

Table 1 Variables and their corresponding values, employed in the analysis

Model variables	
SPU-accredited fellowship positions	30.3
Graduates practicing in the USA, %	100%
Current number of SPU members	325
Annual retirement rate of SPU members, %	3.33%
Annual number of orchiopexies in 2013	20,242
Annual number of hypospadias repairs in 2013	10,121
Annual number of TUR of PUV in 2013	223
Annual number of pyeloplasties in 2013	2747
Annual number of bladder augments for spina bifida patients in 2013	62
Cases performed by pediatric urologists in model 1, %	
Orchiopexies	50
Hypospadias repairs	80
TUR of PUV	80
Pyeloplasties	60
Bladder augments for spina bifida patients	70
2013 US population birth rate (growth rate)	0.80

obtain a steady state. The Summary figure illustrates the projected changes in pediatric urology manpower, eventually leading to a steady state of 900 pediatric urologists in 30 years, a point where the number of retiring pediatric urologists will be replaced by an equivalent number of fellowship graduates on an annual basis.

The annual number of surgeries that had to be performed for each of our chosen index cases was also estimated for the next 30 years. Our estimations were done for 2013, during which there were 3,957,577 births in the United States. A literature review was performed to help calculate the incidence of undescended testis, hypospadias, and posterior urethral valves were found to have approximate incidences of 1 per 100, 1 per 200, and 11.02 per 100,000 male births, respectively [12—14]. Knowing the male-to-female birth ratio in the United States for the year 2013 and assuming that all these patients will undergo surgery, annual numbers were obtained for those three index cases. The annual number for pyeloplasty was estimated from a 2014 article that used the Pediatric Health Information System (PHIS) as their database and came to the conclusion that pyeloplasty was performed in 69.4 per 100,000 inpatients in 2011 [15]. Finally, the incidence of spina bifida is approximately 29.01 per 100,000 live births [14]. The bladder augment rate for patients with spina bifida has been estimated to be 5.4%, which allowed us to calculate an approximate annual number of surgeries [17].

The approximate numbers for the index cases for 2013 are presented in Table 1. Future numbers were estimated by adjusting for the 2013 US population birth rate assuming that the birth rate would remain stable for the next 30 years [16]. These numbers are displayed by 10-year interval in Table 1. Table 1 also demonstrates the results of dividing the annual number of index cases by the corresponding estimated manpower for both previously described models; those are the per case volume per surgeon.

The case volumes per pediatric urologist in model 1 decrease drastically over time. Indeed, our model predicts that by enrolling 30 pediatric urology fellows every year for the next 30 years, there is a risk for an almost twofold reduction in case volume per surgeon compared to the present. However, the situation is different in model 2 in which we assume that all cases will eventually be performed exclusively by board-certified pediatric urologists. Therefore, the decrease in case volumes is less significant than in model 1 as there is a progressive shift of cases to board-certified pediatric urologists over 30 years and thus a gradual increase in the numerator of the case volume per surgeon equation.

We then calculated the ratios of future-to-current case volume per surgeons depending on the annual number of fellowship positions offered. Fig. 1 demonstrates this relationship, which compares predicted per-surgeon total case volumes for the year 2043 for both of our models to per-surgeon total case volumes for the year 2013 depending on the yearly number of graduating fellows, which varies from 1 to 30. The relationship is described by the function $y = 15.97 \times -1.00$ for model 1 and $y = 26.55 \times -1.00$ for model 2, where y is the ratio of future-to-current case volume per surgeons, and x is the annual number of pediatric urology subspecialty graduates. Assuming no interval changes in the number of annual pediatric urology positions, that is, continuing to enroll 30 fellows every year, the ratio of future-to-current case volume per surgeons would be 0.53 in model 1, and 0.88 in model 2. The annual number of fellows needed to obtain a future-to-current ratio equal to 1, and therefore to maintain a similar surgical workload, is 16 for model 1, and 26 for model 2 (ratios of 0.98 and 1.01, respectively).

Discussion

A manpower study was conducted by the American Association of Pediatric Urologists in 1991 to help try and determine the number of pediatric urology positions available across the United States prior to coming to a recommendation on the number of pediatric urology fellowship positions to be offered [18]. Case volume per surgeon is only one metric in the supply—demand equation. It does not factor in the role of a pediatric urologist in the non-surgical management of disease or future change in management of conditions.

The active management of surgical manpower is important for multiple reasons. Manpower undersupply risks limiting the access of patients to specialty-trained surgeons who are best suited to manage and treat their disease process. A manpower oversupply risks significant reduction in case volumes, which can lead to decrease in skill maintenance affecting patient outcomes. Both of these situations can compromise patient care.

The "thought experiment" detailed in this article was intended to assess the potential effect of the recent expansion in pediatric urology fellowship programs, which have doubled in the last 25 years, and to look at the relationship between surgeon supply and clinical demand.

Our study demonstrates, by using two different models, that the current number of pediatric urology fellowship training positions in the United States will ultimately lead to a significant decrease in the case volume per surgeons.

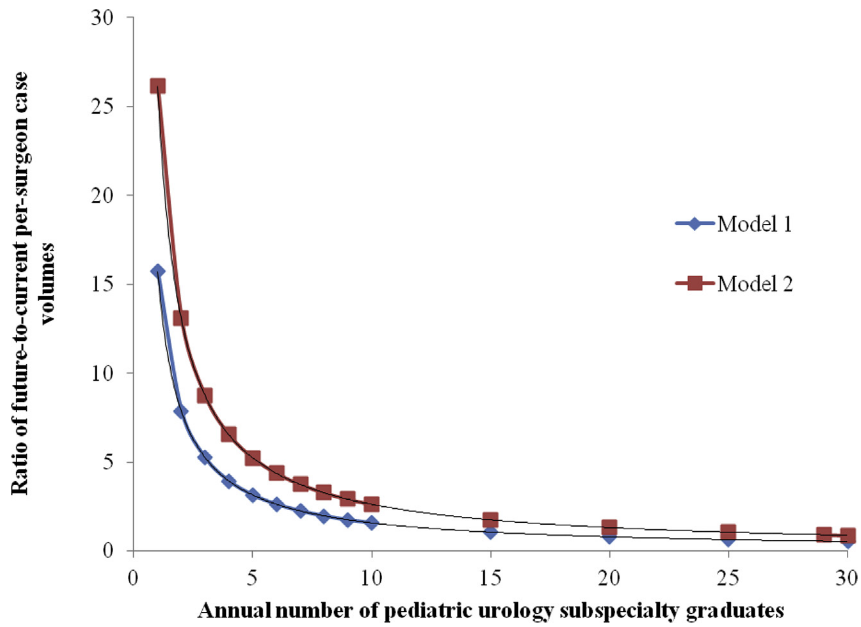

Figure 1 The relationship between predicted per-surgeon total case volumes for the year 2043 for both of our models to per-surgeon total case volumes for the year 2013 depending on the yearly number of graduating fellows, which varies from 1 to 30. Assuming no interval changes in the number of annual pediatric urology positions, that is, continuing to enroll 30 fellows every year, the ratio of future-to-current case volume per surgeons would be 0.53 in model 1, and 0.88 in model 2. The annual number of fellows needed to obtain a future-to-current ratio equal to 1, and therefore to maintain a similar surgical workload, is 16 for model 1, and 26 for model 2 (ratios of 0.98 and 1.01, respectively).

Indeed, with such a drastic change in the pediatric urology workforce, the manpower equation will lose its current equilibrium as the demand will not keep up with the supply.

Pediatric urologists have little control over the demand side of the equation but could consider adjusting the supply side. Reasons to consider limiting the number of pediatric urology fellowship positions based on the prediction in our two models include a potential to maintain surgical skills. However, the number and rate of operative cases to obtain and maintain surgical skills is difficult to define. Many studies have demonstrated a learning curve with respect to surgical skill [19,20]. Resident and fellow training may also be impaired if the operative volume was to significantly decrease at these training centers.

Our model has limitations as it relies on multiple assumptions. We are assuming that all fellowship positions would be filled every year and that all fellows would graduate, establish their practices in the United States and devote 100% of their assumed 30-year professional career to pediatric urology. We are aware it is improbable that all those assumptions will be fulfilled. We also made assumptions of disease occurrence and need for surgical correction, which could be inaccurate or change with time. For example, the number of complex surgical reconstructions may change due to changes in standards of care or due to elective termination of pregnancies. We also estimated the fractions of cases performed by pediatric urologists based on our personal experience, which may not be accurate representation nationally. The final assumption we made was that the birth rate would stay static over the next 30 years even despite the fact that it has been declining for many decades. The nation's "fertility rate", that is how many children each woman is likely to have over her lifetime has decreased to 1.86, which is below the 2.1 children needed to just keep the population stable [15,21].

Our results suggest that according to model 1, there is a risk for a nearly 50% decrease in case volume per surgeon over the next 30 years. Although the decrease is significantly less significant in model 2, it is improbable that all of the pediatric urology surgical cases currently performed by adult urologists and pediatric surgeons will ultimately be done by board-certified pediatric urologists. But this number could increase due to declining interest in managing pediatric urology cases among temporary general practice urologists. The main purpose of presenting model 2 was to demonstrate that even with a situation of 100% case performed by pediatric urologists, there would still be a decrease in case volume per surgeon.

Because of inherent uncertainty around key variables used in this mathematical model, it is important not to extrapolate definitive conclusions from it. Instead, the goal of this exercise was to encourage thoughtful dialog on how to manage the future pediatric urologic manpower. This exercise, even with its inherent limitations, is still sufficient to demonstrate that fellowship expansion (workforce supply) warrants thoughtful discussion. It is vital that our specialty plays an active role in this because it is in the best interest of both our patients and the profession.

Conclusion

There is an impending change in the practice of pediatric urology over the next few decades. Mathematical modeling of future case volumes, in combination with manpower growth allows for the prediction of effect of fellowship expansion. Manpower issues need to be considered by the governing committees of pediatric urology fellowship programs to ensure a healthy and well-trained workforce.

Funding

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Conflicts of interest

None.

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