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ORIGINAL PAPER

A global snapshot of endourology residency training

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Summary ***Background: Urology has become more complex over the last decades with surgical sophisticated technologies such as endoscopy, laparoscopy and robotic surgery. As these minimally invasive methods gain popularity throughout the world, this has led in some countries to a serious training gap as compared to other countries, and between generations of surgeons within national training systems. There is a huge heterogeneity in urological training between countries, whether developed or developing. This paper attempts to shed some light onto global urological training, comparing a significant number of various national systems, and to outline global tendencies in urological training. It will enable interested readers to see where their own system stands in international comparison, and hopefully enable them to identify training needs to achieve global quality standards.***
Materials & methods: This is a questionnaire-based assessment which was sent to 240 members of U-merge from 62 countries. In addition, there is ample literature on the requirements of structured training programs and assessments, and we have tried to briefly outline the key points in this paper.
Results: We received responses from 32 countries Urology residency training is hugely heterogenous between countries. Only 44% of nations use a structured training program with assessments. Others use the Halstedian apprenticeship approach. Notably, some developing countries do use modern teaching and assessment methods, whereas some developed countries still use the outmoded apprenticeship model. For the interested reader, results have been tabled in detail, and training systems described country by country.
Conclusions: Our results have shown a huge heterogeneity in quality urology training between countries and within continents. In systems without national structure of training, it can be assumed that such differences exist even between hospitals/ training institutions. There is no doubt in times of globalization with resident and doctor migration and exchanges that training needs structure and standardization. The still huge gap in developing countries to catch up and be able to afford latest surgical and learning technologies need to be addressed with the help of responsible outreach programs.

KEY WORDS: Surgical training; Urology; Endourology; Performance assessment; DOPS; Dry lab; Wet lab; Simulator training; Global education.

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INTRODUCTION

An estimated 5 billion people lack access to any surgical care. This despite surgical diseases accounting for 11-30% of the global health care burden (1). This implies an urgent need to quality-train more surgeons in all specialties globally.

Historically, surgical training, and urological training as a surgical sub-specialty as well, followed the Halstedian tradition of defined apprenticeship. This includes basically observation, modelling and graded participation in surgical activities. This model of training is characterized through long working hours, poorly defined training goals, and a lack of focus on research and evidence-based best practice. In this traditional system, assessment and evaluation of the trainees' performance is outmoded, significantly subjective, with standards ill-defined and not uniformly applied (2). The optimal method to monitor and assess trainees, for example in endoscopy, has not been formally determined (3). Urology has become more complex over the last decades with increasing medical and surgical sophisticated technologies such as endoscopy, laparoscopy and robotic surgery. As these minimally invasive methods gain popularity throughout the world, this has led in some countries to a serious training gap as compared to other countries (4), and between generations of surgeons within national training systems. There is a huge heterogeneity in urological training between countries, whether developed or developing (5, 6). Most countries have a urological training duration of around 5 years, but this may include rotations in nephrology, pediatric surgery, gynecology, general surgery, anesthesia, pathology and others (4). Numerous recent studies have shown that trainees remain dissatisfied with their training in urology in many countries (7-12). The educational landscape in urology training is changing and adapting to modern learning methods. Globalization of demands and services also means there clearly is a need for a standardized and structured urological training for global use.

This must also include competency-based assessment, certification and re-certification (3). Naturally, these changes are adopted by various countries in various ways and speeds. This has led at the current time to a wide variation of training quality between countries and training systems.

U-merge is a urological educational platform. Its members are active in international teaching & training in many countries globally. Therefore, the authors have seen first-hand huge differences in structures and quality of urological training programs. Programs may vary from the old-

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fashioned apprenticeship model with a see one, do one, teach one approach, to highly structured, sometimes nationalized training programs using modern technologies such as virtual, simulated and telemedical training.
This paper attempts to shed some light onto global urological training, comparing a significant number of various national systems, and to outline global tendencies in urological training. We focus on endourology and pediatric endourology training as representative for recent technological changes in urology.
This paper will enable interested readers to see where their own system stands in international comparison, and hopefully enable them to identify training needs to achieve global quality standards.

Materials and methods

This paper is based on a questionnaire which was sent in 2015 to 240 members of U-merge from 62 countries (Appendix 1). U-merge members are consultant level academic urologists in their respective countries.
The questionnaire addressed

- Structure and duration of the urology training program
- Training in basic urology and endourology (if any)
- Sub-specialty training in pediatric urology
- Assessment structure
- Availability of simulated training options.

No funding has been obtained to conduct this study.

Results

Cumulative results

Of 240 questionnaires emailed to U-merge members in 60 countries, we received 37 (15.4%) responses from 32 countries. Twenty-one (56%) of these have no structured training program. Urology training follows an apprenticeship model. The other 16 have a structured training program. Endourology training can be integrated into the mainstream residency training or have its own defined training period. Duration of training within structured programs varies from 0.5 to 6 years. In 7 (18%) countries, urology residency training can be completed without gaining competency in endourology. 8 (21%) do not require URS, 17 (46%) do not require fURS/RIRS, and 18 (48%) do not require PCNL competency. 3 (8%) countries require endourology training in children (Table 1).
As per specific endourological procedures, 22 (59%) of countries require their trainees to be independently competent in URS, 5 (13%) to be competent with assistance, and 2 (5%) require mere exposure during training. In 10 (27%) URS training has not been specified.
For fURS/RIRS, the numbers are 9 (24%), 10 (27%), 6 (16%), and 13 (35%), respectively. For PCNL the numbers are 6 (16%), 13 (35%), 9 (24%), and 12 (32%), respectively. For endourological procedures in children, independent competency is usually not required to complete urology residency. 4 (11%) of countries require

Table 1.
Structured urology training programs and endourology components by country.

Country	Structured endourology training	Duration endourology training program (years)	Completion of training without competence in endouro procedures	Completion of training without competence in URS	Completion of training without competence in fURS/RIRS	Completion of training without competence in PCNL	Completion of training without competence in EndoUro in Children
Algeria	No	Not applicable	Yes	No	No	No	Yes
Austria	No	Not applicable	Yes	No	No	No	Yes
Australia	Yes	6	Yes	No	No	No	Yes
Bangladesh	No	Not applicable	Yes	Yes	Yes	Yes	Yes
Brazil	Yes	0,5	Yes	No	Yes	No	Yes
Bulgaria	Yes	1	Yes	No	No	No	Yes
Canada	No	Not applicable	Yes	No	No	Yes	Yes
China	No	Not applicable	Yes	No	No	Yes	Yes
Colombia	No	Not applicable	Yes	No	Yes	Yes	Yes
Egypt	No	Not applicable	Yes	No	Yes	No	Yes
El Salvador	No	Not applicable	Yes	Yes	Yes	Yes	Yes
France	No	Not applicable	No	No	No	No	Yes
Germany	Yes	5	Yes	No	Yes	Yes	Yes
Greece	No	Not applicable	Yes	No	Yes	Yes	Yes
India	Yes	5	Yes	No	Yes	Yes	Yes
Iran	Yes	2	Yes	No	Yes	Yes	Yes
Iraq	Yes	3	Yes	Yes	Yes	Yes	Yes
Ireland	Yes	6	No	No	No	No	Yes
1Italy	no	Not applicable	Yes	Yes	Yes	Yes	Yes
Kenya	Yes	4	Yes	No	No	No	Yes
Kurdistan	Yes	1	No	No	No	No	Yes
Moldova	No	Not applicable	Yes	No	Yes	Yes	Yes
Morocco	Yes	5	Yes	Yes	Yes	Yes	Yes
Nepal	Yes	3	No	No	No	No	No
Oman	No	Not applicable	Yes	Yes	Yes	Yes	Yes
Pakistan	Yes	6	Yes	No	No	No	Yes
Panama	No	Not applicable	Yes	No	No	No	Yes
Romania	No	Not applicable	Yes	No	No	No	Yes
Serbia	No	Not applicable	Yes	No	No	Yes	Yes
South Africa	No	Not applicable	No	No	No	No	No
Spain	No	Not applicable	Yes	Yes	Yes	Yes	Yes
Sweden	Yes	5	Yes	No	No	No	Yes
Syria	No	Not applicable	Yes	No	Yes	Yes	Yes
Tunisia	Yes	2	No	No	No	No	No
UAE	No	Not applicable	Yes	Yes	Yes	Yes	Yes
UK	Yes	5	No	No	No	No	Yes
Ukraine	No	Not applicable	Yes	No	No	No	Yes

Table 2.
Core competencies required in endourology by country.

Country	URS Perform independently	URS perform with assistance	URS exposure	URS Lwarn at specialist fellowship level	URS not specified	fURS/RIRS Perform independently	fURS/RIRS perform with assistance	fURS/RIRS exposure	fURS/RIRS Learn at specialist fellowship level	fURS/RIRS not specified	PCNL Perform independently	PCNL perform with assistance	PCNL exposure	PCNL Learn at specialist fellowship level	PCNL not specified	Endourol in children Perform independently	Endourol in children perform with assistance	Endourol in children exposure	Endourol in children Learn at specialist fellowship level	Endourol in children not specified
Algeria	Yes					Yes						Yes		Yes						Yes
Austria					Yes					Yes					Yes					Yes
Australia	Yes					Yes						Yes							Yes	
Bangladesh		Yes							Yes			Yes							Yes	
Brazil	Yes							Yes				Yes								Yes
Bulgaria	Yes						Yes						Yes						Yes	
Canada	Yes			Yes		Yes			Yes		Yes			Yes						Yes
China		Yes						Yes					Yes							Yes
Colombia	Yes						Yes					Yes								Yes
Egypt	Yes						Yes				Yes						Yes			
El Salvador					Yes					Yes					Yes					Yes
France	Yes					Yes					Yes									Yes
Germany		Yes								Yes					Yes					Yes
Greece					Yes					Yes					Yes					Yes
India	Yes						Yes					Yes								Yes
Iran	Yes									Yes			Yes					Yes		
Iraq	Yes						Yes	Yes				Yes	Yes	Yes			Yes	Yes	Yes	
Ireland	Yes					Yes						Yes							Yes	
Italy					Yes					Yes					Yes					Yes
Kenya	Yes					Yes						Yes	Yes	Yes					Yes	
Kurdistan	Yes						Yes					Yes								Yes
Moldova	Yes									Yes					Yes					yes
Morocco			Yes					Yes					Yes					Yes		
Nepal	Yes	Yes				Yes	Yes				Yes	Yes								Yes
Oman																				
Pakistan	Yes						Yes					Yes					Yes			
Panama					Yes					Yes					Yes					Yes
Romania	Yes						Yes				Yes									Yes
Serbia					Yes										Yes					
South Africa					Yes					Yes					Yes					Yes
Spain					Yes					Yes					Yes					Yes
Sweden	Yes	Yes	Yes			Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes						Yes
Syria	Yes									Yes			Yes				Yes			
Tunisia	Yes							Yes						Yes						Yes
UAE					Yes					Yes					Yes					Yes
UK	Yes					Yes							Yes							Yes
Ukraine					Yes					Yes					Yes					Yes

competency with assistance by trainers, and 3 (8%) require some exposure during training. Some countries offer post-residency training on a fellowship level: 3 (8%) for fURS/RIRS, 6 (16%) for PCNL, and 6 (16%) for pediatric procedures, respectively (Table 2). Twenty-one (56%) countries have defined a minimum procedure number for endourology training: 20 (54%) for URS, 13 (35%) for fURS/RIRS, 18 (48%) for PCNL, and 7 (19%) for pediatric endourological procedures. Indicative numbers vary widely: 10-450 for URS, 10-100 for fURS/RIRS, 6-250 for PCNL, and 2-300 for pediatric procedures, respectively (Table 3). Twenty-six (70%) countries have no structured performance assessment during training in place. 19 (51%) rely on a general assessment, 12 (32%) perform regular audit, 9 (24%) use examinations as a tool of assessment, and 14 (38%) apply formal *Direct Observation of Procedural Skills* (DOPS) (Table 4). Regarding simulated surgical skills training, 7 (19%) have a "dry lab" facility for URS at their disposal, another 7 (19%) have a "wet lab" training option for URS. 6 (16%) have these as a compulsory training part in their programs. Each 6 (16%) countries offer either for fURS/RIRS training, and 6 (16%) offer "dry lab" and 5 (13%) "wet lab" training for PCNL. Each 3 (8%) use these as compulsory part of training (Table 5).

Results by country

As mentioned before, twenty-one (56%) countries have no structured training program (Figure 1). Urology training follows an apprenticeship model. Another 16 have a structured training program of varying duration and performance assessments (Figure 2). In the following we present a short summary for the urological training in all responder countries in alphabetical order.

The following 21 countries have NO structured training program:

1. Algeria

The completion of urological training includes competence in URS (semi-rigid ureteroscopy), fURS/RIRS (flexible ureteroscopy/retrograde intrarenal surgery) and PCNL (percutaneous nephrolithotomy), with exception of endourological procedures in children. Trainees are expected to perform a minimum of 10 cases each of URS and fURS/RIRS. In addition, fifteen PCNL with trainer assistance is a requirement. There is compulsory wet lab training on animal models for URS, fURS/RIRS and PCNL. No structured method of performance assessment has been specified.

2. Austria

For endourological procedures (URS, fURS/RIRS, PCNL) a combined minimum case load of 150 procedures is required. There is no specified level of competence for these endourologal procedures in children. There is no

Table 3.
Minimum endourology procedure numbers required by country.

Country	Min No. of case load	URS Min No. of Case Load	URS indicative number	fURS/RIRS min no. of caseload	fURS/RIRS indicative numbers	PCNL min no. of caseload	PCNL indicative numbers	Endourology in chilidren min no. of caseload	Endourology in children indicative numbers	All 4 procedures combined case numbers	Not specified
Algeria	Yes	Yes	10	Yes	10	Yes	15	No	0	Not mentioned	
Austria	Yes	Yes	Not mentioned	Yes	Not mentioned	Yes	Not mentioned	Yes	Not mentioned	150	
Australia	Yes	Yes	100	Yes	75	Yes	15	No	0	Not mentioned	
Bangladesh	No	No	0	No	0	No	0	No	0	No	
Brazil	Yes	Yes	12	No	No	Yes	6	No	No		
Bulgaria	Yes	Yes	50	Yes	10	Yes	10	No	No	Not mentioned	
Canada	No	No	Not mentioned	No	Not mentioned	No	Not mentioned	No	Not mentioned	Not mentioned	
China	No	No	Not mentioned	No	Not mentioned	No	Not mentioned	No	Not mentioned	Not mentioned	
Colombia	No	No		No		No		No		Not mentioned	
Egypt	Yes	Yes	60	Yes	20	Yes	30	Yes	10	Not mentioned	
El Salvador	No	No	No	No	No	No	No	No	No	Not mentioned	
France	No	Yes	50	Yes	50	Yes	20	No	No	Not mentioned	
Germany	No	Yes	50	No	No	No	No	No	No	Not mentioned	
Greece	No	No	No	No	No	No	No	No	No	Not mentioned	
India	Yes	Yes	20	Yes	20	Yes	5	Yes	2	Not mentioned	
Iran	Yes	Yes	70	No	No	Yes	50	Yes	10	Not mentioned	
Iraq	Yes	Yes	450	Yes	30	Yes	60	Yes	300	Not mentioned	
Ireland	Yes	Yes	50	Yes	50	Yes	10	No	No	Not mentioned	
Italy	no	No									Yes
Kenya	Yes	Yes	50	Yes	50	Yes	30	No	No	Not mentioned	
Kurdistan	Yes	Yes	200	Yes	100	Yes	250	Yes	20	Not mentioned	
Moldova	No	No									Yes
Morocco	No	No	No	No	No	No	No	No	No	Not mentioned	
Nepal	Yes	Yes	200	Yes	25	Yes	100	No	Not mentioned	Not mentioned	
Oman											Yes
Pakistan	Yes	Yes	400	No	No	Yes	250	No	No	Not mentioned	
Panama	No										Yes
Romania	Yes	Yes	20	No	No	Yes	20	No	No	Not mentioned	
Serbia	Yes	Yes	50	No	No	No	No	No	No	Not mentioned	
South Africa	No	No	No	No	No	No	No	No	No	Not mentioned	
Spain	No	No	No	No	No	No	No	No	No	Not mentioned	
Sweden	No	No	No	No	No	No	No	No	No	Not mentioned	
Syria	No	No	No	No	No	No	No	No	No	Not mentioned	
Tunisia	Yes	Yes	Not mentioned	No	No	Yes	20	No	No	Not mentioned	
UAE	No	No									Yes
UK	Yes	Yes	50	Yes	50	Yes	10	Yes	10	Not mentioned	
Ukraine	No	No	No	No	No	No	No	No	No	Not mentioned	

Table 4.
Performance assessments by country.

Country	General assessment of performance	Audit	Formal examination/viva	Direct Obs of Procedure Skills (DOPS)	Several of above assessments	No specific assessment
Algeria	No	No	No	No	No	Yes
Austria	Yes	Yes	Yes	No	Yes	No
Australia	Yes	Yes	Yes	Yes	Yes	No
Bangladesh	No	No	No	No	No	Yes
Brazil	No	No	No	No	No	Yes
Bulgaria	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Yes	No
Canada	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Yes	No
China	No	Yes	No	Yes	Yes	Yes
Colombia	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Yes	Yes
Egypt	Yes	No	Yes	Yes	Yes	Yes
El Salvador	No	No	No	No	No	No
France	Yes	Yes	Yes	Yes	Yes	Yes
Germany	No	No	No	No	No	No
Greece	Yes	No	No	Yes	Yes	Yes
India	Yes	No	No	No	No	Yes
Iran	Yes	Yes	No	Yes	Yes	Yes
Iraq	Yes	Yes	Yes	Yes	Yes	Yes
Ireland	Yes	Yes	No	Yes	Yes	Yes
Italy						
Kenya	Yes	Yes	Yes	Yes	Yes	Yes
Kurdistan	Yes	Yes	No	Yes	Yes	Yes
Moldova	No	No	No	No	No	No
Morocco	Yes	No	No	No	No	Yes
Nepal	Yes	Yes	Yes	No	Yes	Yes
Oman						No
Pakistan	Yes	Yes	Yes	No	Yes	Yes
Panama	No	No	No	No	No	No
Romania	No	No	No	No	No	No
Serbia	Yes	No	No	No	No	Yes
South Africa	Yes	No	No	Yes	Yes	Yes
Spain	No	No	No	No	No	No
Sweden	No	No	No	Yes	No	Yes
Syria	Not mentioned	Not mentioned	Not mentioned	Not mentioned	Yes	Yes
Tunisia	Yes	Yes	No	Yes	Yes	Yes
UAE						
UK	Yes	No	Yes	Yes	Yes	Yes
Ukraine	Yes	No	No	No	No	Yes

Table 5.
Availability and integration of dry & wet lab model training into the training program by country.

Country	URS DryLab	URS WetLab	URS Compulsory	FURS DryLab	FURS WetLab	FURS Compulsory	PCNL DryLab	FURS WetLab	FURS Compulsory
Algeria	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Austria	No	No	No	No	No	No	No	No	No
Australia	No	No	No	No	No	No	No	No	No
Bangladesh	No	No	No	No	No	No	No	No	No
Brazil	NS	NS	No	NS	NS	No	NS	NS	No
Bulgaria	Yes	No	Yes	Yes	No	Yes	Yes	No	No
Canada	No	No	No	No	No	No	No	No	No
China	Yes	No	No	Yes	Yes	No	Yes	Yes	No
Colombia	No	No	No	No	No	No	No	No	No
Egypt	No	No	No	No	No	No	No	No	No
El Salvador	No	No	No	No	No	No	No	No	No
France	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
Germany	No	Yes	Yes	No	No	No	No	No	No
Greece	No	No	No	No	No	No	No	No	No
India	Yes	No	No	Yes	No	No	Yes	No	No
Iran	No	No	No	No	No	No	No	No	No
Iraq	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Ireland	No	No	No	No	No	No	No	No	No
Italy	No	No	No	No	No	No	No	No	No
Kenya			No			No			No
Kurdistan			No			No			No
Moldova	No	Yes	Yes	No	No	No	No	No	No
Morocco			No			No			No
Nepal	No	No	No	No	No	No	No	No	No
Oman									no info
Pakistan			No			No			No
Panama			No			No			No
Romania			No			No			No
Serbia	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No
South Africa	No	No	No	No	No	No	No	No	No
Spain	No	No	No	No	No	No	No	No	No
Sweden	Yes	Yes	No	Yes	Yes	No	No	No	No
Syria	No	No	No	No	No	No	No	No	No
Tunisia	Yes	No	Yes	No	Yes	No	Yes	No	Yes
UAE									no info
UK	No	No	No	No	No	No	No	No	No
Ukraine	No	No	No	No	No	No	No	No	No

compulsory dry or wet lab training. The assessment is via general assessment of performance, audit and formal examination with viva by the trainers.

3. Bangladesh
Trainees can achieve completion of training without proven competence in fURS/RIRS, PCNL and endourological surgery in children. They are required to perform some URS and PCNL with trainer assistance.
Endourology in children is later taught at fellowship level. Indicative numbers of procedure and performance assessment methods are not specified.

4. Canada
URS and fURS/RIRS are a requirement for completion of training with candidates expected to perform these procedures independently. Endourology in children and PCNL is taught at fellowship level post-residency. Model training is not compulsory. Various method of assessment of performance are in place.

5. China
For completion of training, URS with trainer assistance is required. However, trainees are expected to have had exposure to fURS and PCNL. There is no specified endourology training in children. There is dry lab training for URS and wet lab training for fURS and PCNL, albeit not compulsory. Audit and DOPS are used for assessment.

6. Colombia
URS is mandatory and trainees are expected to perform it independently. fURS and PCNL with trainer assistance are required. Endourology in children is not regulated. There is no model training and no specific assessment structure in place.

7. Egypt
Trainees can complete their training without gaining independent level competence in fURS/RIRS and endourological procedures in children. Twenty and 10 assisted or observed cases in fURS and paediatric endourology, respectively, are indicative, albeit not mandatory. URS and PCNL procedures are compulsory for the trainee to perform independently, with indicative numbers of 60 and 30, respectively. There is no compulsory model training. Assessment of performance is via formal examination with viva and DOPS.

8. El Salvador
There is no specified mandatory requirement for any endourological procedures. Indicative numbers, provision of model training, or assessment methods are not specified.

9. France
There is no structured endourology training program. However, it is mandatory to achieve competence in URS, fURS/RIRS and PCNL. Endourological procedures in children is not a mandatory requirement. Fifty cases each for URS and fURS/RIRS, and 20 cases of PCNL are indicative, with numbers unspecified for paediatric endourology. There are dry and wet labs for each of these procedures. However, model training is not compulsory.

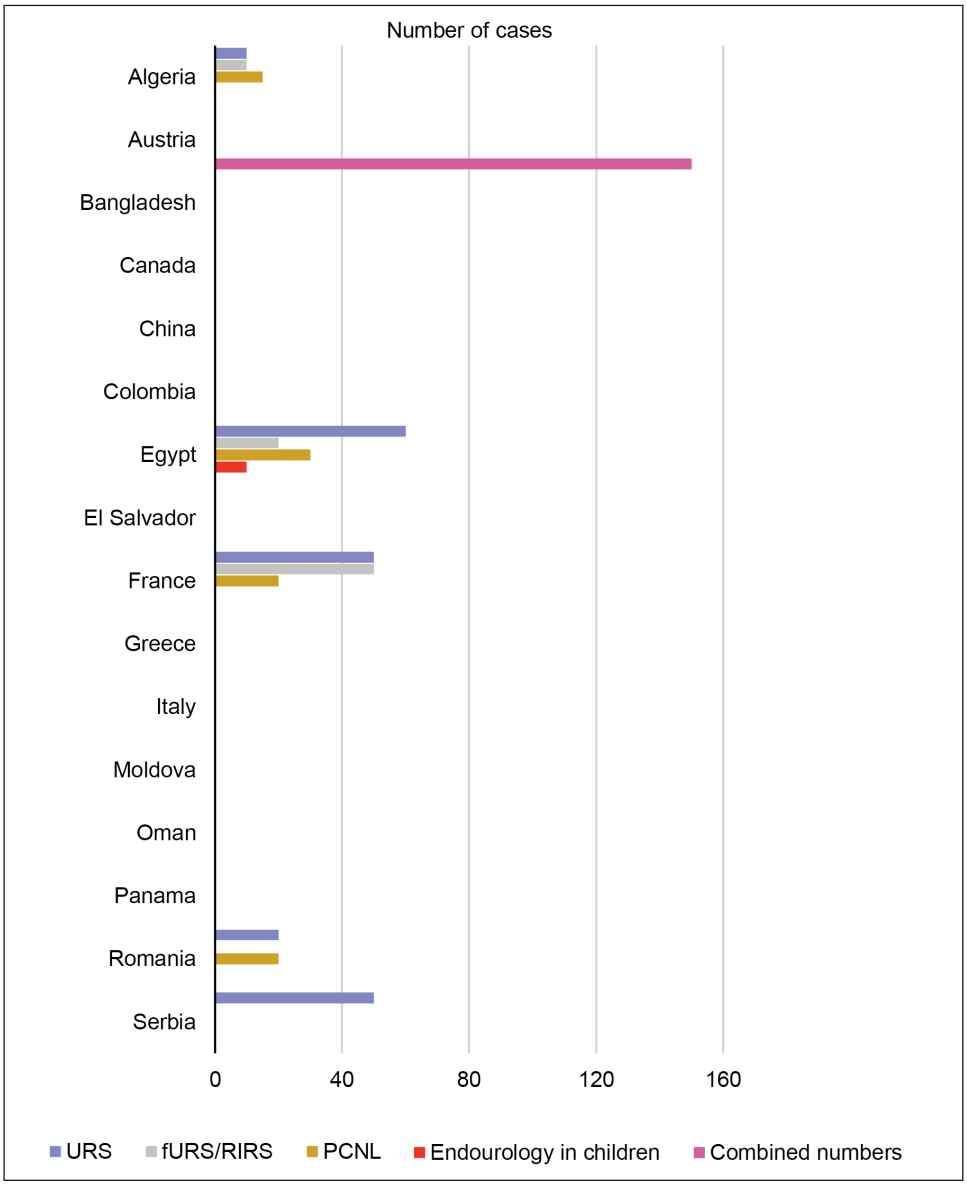

Figure 1.
Countries with no structured (endourology) training and indicative numbers of procedures (empty bars indicate no minimum number specified).

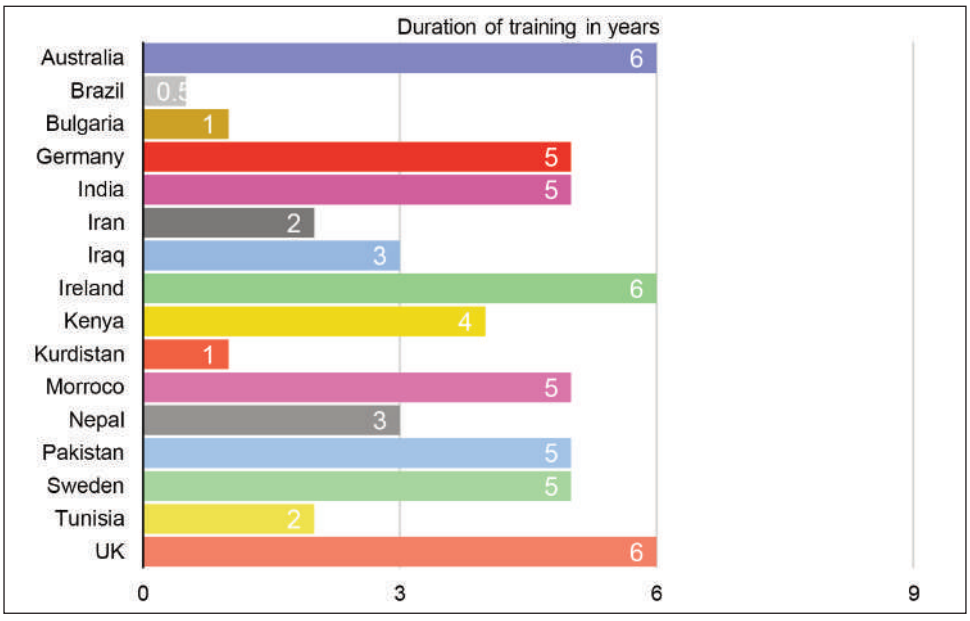

Figure 2.
ountries with structured (endourology) training programs: duration of training.

Assessment of performance is via several methods including audit, general assessment, formal examination and viva with DOPS.

10. Greece
URS is a mandatory requirement with no specified indicative numbers. Completion of training is possible without further competence in endourology.
There is no provision of model training. Assessment of performance is via general assessment and DOPS.

11. Italy
There are no competence requirements for endourology. Indicative numbers are unspecified. There is no provision of model training. Assessment methods are not specified.

12. Moldova
Trainees are expected to gain independent level competence in URS for completion of training with unspecified indicative numbers. There is compulsory URS wet lab on animal models. The performance assessment method is unspecified.

13. Oman
Endourology is not a mandatory requirement for completion of training. There are no specified indicative numbers, model training or assessment methods.

14. Panama
URS, fURS/RIRS and PCNL are mandatory requirements for completion of training, however indicative numbers are not specified. Dry and wet labs are not available, and there is no specified method of assessment.

15. Romania
Although there is lack of structured endourology training, for completion of training it is mandatory to achieve competence in URS, fURS/RIRS and PCNL.
URS and PCNL are expected to be performed independently, fURS with trainer assistance. Twenty cases for URS are indicative. Dry and wet labs are not compulsory, and assessment of competency is not specified.

16. Serbia
URS and fURS/RIRS are mandatory requirements to complete training with 50 cases for URS as indicative number. Dry and wet labs for each of these procedures are accessible by trainees, but not compulsory.
Competency is assessed by general assessment.

17. South Africa
It is mandatory to achieve competence in endourology for completion of training. Trainees are required to gain competence in all procedures (URS, fURS/RIRS, PCNL and paediatric endourology). Level of competence is not specified with no indicative numbers. There are no dry or wet labs. Assessment of performance is via general assessment and DOPS.

18. Spain
Trainees are not required to gain competence in endourology to complete training. There are no specified indicative numbers, lab provisions or assessment methods.

19. Syria
Trainees are required to gain independent level competence in URS with exposure to PCNL and assistance in paediatric endourology. fURS training is not specified. There are no minimum case numbers and model training. Assessment of performance is not specified.

20. United Arab Emirates
There is no specific training program.

21. Ukraine
URS, fURS/RIRS and PCNL are mandatory for completion of training, however core competency, indicative numbers and lab provision are not specified. There is a general assessment of competency.

The following 16 countries do have a structured training program (Figure 3):

1. Australia
The training program runs for 6 years. It is mandatory to achieve competence in endourology for completion of training such as independent level competence in URS and fURS/RIRS. Performance of PCNL with assistance is a requirement. Paediatric endourology is learned at fellowship level. Indicative numbers include 100 URS, 75 fURS/RIRS, and 15 PCNL with no specified numbers for paediatric endourology. Dry and wet labs are not provisioned. Assessment of performance is via several methods including audit, general assessment, formal examination and viva with DOPS.

2. Brazil
A 6 month endourology program is in existence with mandatory expertise in URS. PCNL with assistance and exposure to fURS/RIRS is deemed satisfactory. Twelve URS and 6 PCNL are indicative for completion of training. There are no specified numbers for paediatric endourology. Lab training is not provisioned and there is no specified method of assessment of competence.

3. Bulgaria
An endourology program of 1-year duration exists with trainees expected to perform URS independently and PCNL with assistance. Exposure to fURS/RIRS is mandatory. Paediatric endourology is learned at fellowship level. Indicative numbers for each of these procedures are 50 URS, 10 each fURS/RIRS and PCNL. A dry lab is compulsory for each category, with the exception of endourology in children. Assessment of performance is via several methods including audit, general assessment, formal examination and viva with DOPS.

4. Germany
A 5-year urology training program is in place. Endourology training comprises of mandatory URS. fURS/RIRS, PCNL and endourology in children is not specified. Fifty URS procedures are indicative. Wet lab for URS is compulsory. Assessment of performance is via several methods.

5. India
Expertise in URS is mandatory as part of a 5-year uro-

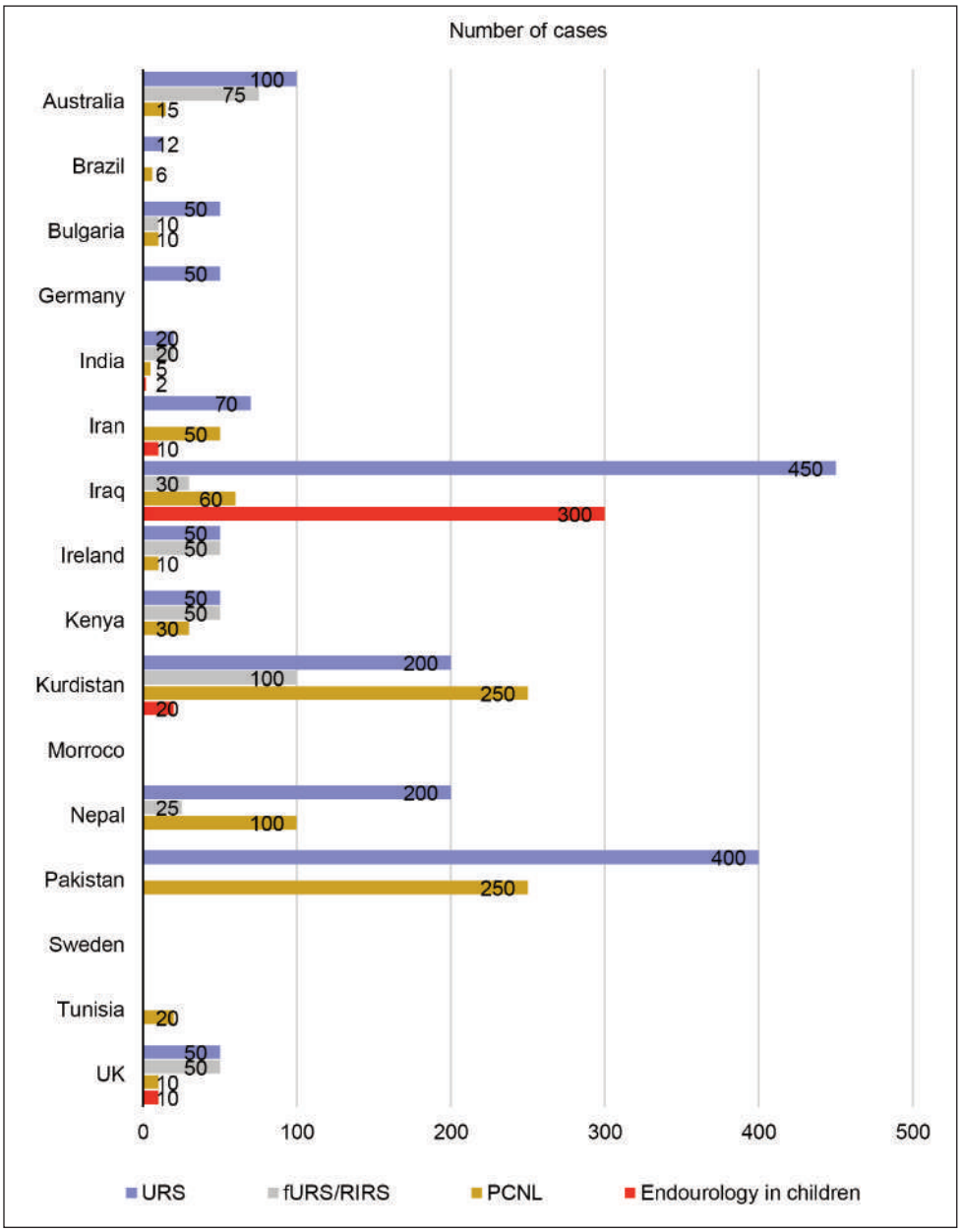

Figure 3.
Countries with structured endourology training and indicative numbers of procedures required (empty bars indicate no number specified).

logical training program. fURS/RIRS and PCNL are accepted to be performed with assistance. Paediatric endourology is not specified. Indicative numbers include 20 for URS, 20 for fURS/RIRS, 5 for PCNL and 2 in paediatric endourology.
There is a provision of dry lab for each of these procedures, albeit not compulsory. Assessment of performance is via general assessment.

6. Iran
An endourology program runs for 2 years with independent expertise in URS being mandatory. PCNL and paediatric endourology exposure is necessary, whereas fURS/RIRS is not specified. Seventy URS, 50 PCNL and 10 paediatric endourology cases are indicative. There is no provision of dry and wet labs. Assessment of performance is via several methods including audit, general assessment and DOPS.

7. Iraq
Endourology training for 3 years is mandatory, however trainees can finish training without gaining independent level competence in either of the endourology procedures with exception being URS. A minimum of 450 cases of URS, 30 of fURS/RIRS, 60 of PCNL and 300 of paediatric endourology are indicative. There is provision of dry and wet labs for each of these procedures which are compulsory. Assessment of performance is via several methods including audit, general assessment, formal examination and viva with DOPS.

8. Ireland
A 6-year training program exists, with a structured endourology training. URS, fURS/RIRS and PCNL are mandatory, with paediatric endourology learned at fellowship level. Trainees are required to gain independent level competence in URS and fURS/RIRS, with PCNL

performed with trainer assistance. Indicative numbers 50 URS, 50 fURS, and 10 PCNL. There is no provision of lab training. Assessment of performance is via several methods including audit, general assessment, formal examination and viva with DOPS.

9. Kenya
URS, fURS/RIRS and PCNL are mandatory to achieve competence in endourology for completion of a 4-year training program. Paediatric endourology is performed at fellowship level hence not a requirement for completion of training. Trainees are expected to perform URS and fURS/RIRS independently, and PCNL with assistance. Fifty cases each for URS and fURS/RIRS, and 30 cases of PCNL are indicative. Lab is not provisioned. Assessment of performance is via several methods including audit, general assessment, formal examination and viva with DOPS.

10. Kurdistan
A one-year structured endourology training program makes it mandatory for trainees to be independently proficient to perform URS and fURS/RIRS, and PCNL to be performed with assistance. There is no specified paediatric endourology training. Two hundred cases for URS, 100 for fURS/RIRS, 250 cases of PCNL, and 20 paediatric endourology cases are indicative. There is no provision of lab training. Several methods such as general assessment, audit and DOPS are used for assessment.

11. Morocco
The training program comprises endourology training and runs for 5 years. Trainees are required to gain exposure to URS, fURS/RIRS and PCNL in order to complete their training. Endourological procedures in children are not a mandatory requirement. There are no specified indicative numbers, and no lab training. General assessment of performance exists to assess competency.

12. Nepal
It is mandatory to achieve competence in endourology for completion of training of a 3-year training. Trainees are required to gain independent level competence in URS, with fURS/RIRS and PCNL to be performed with trainer assistance. Endourological procedures in children are not a mandatory requirement. Two hundred cases for URS, 25 for fURS/RIRS, and 100 cases of PCNL are indicative, with no particularly specified numbers for paediatric endourology. There is no provision of lab training. Audit, general assessment, formal examination and viva are in place to assess competency of training.

13. Pakistan
A 5-year program exists with mandatory endourology training. Trainees are required to gain independent level competence in URS, with fURS/RIRS and PCNL performed with trainer assistance. Endourological procedures in children are not a mandatory requirement. Four hundred cases for URS and 250 cases of PCNL are indicative, with no particularly specified numbers for fURS/RIRS and paediatric endourology. There is no provision of dry and wet labs for each of these procedures. Several methods exist including audit, general assessment, formal examination and viva to assess competency.

14. Sweden
It is a mandatory requirement to achieve competence in endourology for completion of a 5-year training program. Trainees are required to gain independent level competence in URS, fURS/RIRS and PCNL in order to complete their training. Endourological procedures in children and indicative numbers are not specified. There are dry and wet labs for URS and fURS/RIRS, which are however not compulsory. Assessment is via DOPS.

15. Tunisia
A 2-year training program exists comprising of endourology training in URS and fURS/RIRS. PCNL is learned at fellowship level. Paediatric endourology is not specified. Trainees are required to gain independent level competence in URS. Twenty PCNL performed with assistance are indicative. A compulsory dry lab for URS and PCNL exists with optional fURS wet lab. Assessment is via audit, general assessment, formal examination and DOPS.

16. United Kingdom
The UK training program runs for 5 years with mandatory competence in URS, fURS/RIRS and PCNL. Endourological procedures in children are not a mandatory requirement. Trainees are required to perform URS and fURS/RIRS independently, with PCNL exposure, and no specified paediatric endourology. Fifty cases each for URS and fURS/RIRS, and 10 cases of PCNL, as well as 10 cases of paediatric endourology as indicative.
There is no compulsory lab training. Competency assessment is via several methods including audit, general assessment, formal examination, viva and DOPS.

Discussion

Our results have shown that there is a huge heterogeneity between training systems in various countries.
This has previously been confirmed by others (5,6). Urological training, although embracing modern learning technologies in many countries, is far from ideal in most places. Inevitably, that will lead to huge differences in the training quality as well.
In Europe, there is a general lack of standardized training curricula. Great differences exist between training requirements in different countries. Trainees complain about a lack of confidence when performing major surgical procedures, non-compliance with European working hour regulations, a worrisome risk of burn-out and a negative impact on their work-life balance (6). Irish residents complain mainly about a lack of operative experience (7). In Spain, trainees find their training inadequate because of a lack of supervision, trainers completing their own training needs first, and a lack of operative experience (10). In Germany, 45% of trainees feel unprepared for their future roles. 85% complain about a lack in structured training, evaluations, and transparency. Another complaint is economic constraints during training (8). Throughout *South America*, training, accreditation and re-certification are highly heterogenous and far

from being standardized. In addition, academic activities are not properly valued (5).
Turkish residents report a lack of surgical exposure, and of encouragement for any academic activities (11). In Tunisia, most trainees in urology were dissatisfied with their training (9).
Training is further compromised by reduced working hours for training as well as an increasing threat of litigation (12).
All these studies confirm that there is a dire need to improve training quality in urology internationally. Not only may patient safety be compromised, but even the trainees themselves will face a future that they do not feel ready for, and that they are not adequately trained for.
So how could one achieve a meaningful improvement?
It appears that a well-structured training approach is key to ensure a surgeon's professional growth in the safest way for the patients (4).
Structured training is in place in some countries who may serve as a model for others. Structuring the training may start with the right candidate selection. A surgeon needs compassion, communication skills, and should be perceptive and dedicated, besides manually skilled (2). Structuring this crucial initial step of training, recruitment should be at least regional, if not national. Candidates must undergo a validated assessment by objective, well-trained and experienced assessors. The process should be overseen by national authorities such as colleges or deaneries. This way each candidate will have the same chances and will undergo the same assessment, decreasing the chance of subjective bias. The UK system may serve here as an example (13).
The next step to structure would be the training program itself. Most modern training programs have already moved from a "*see one, do one, teach one*" approach to a structured learning – at least in minimally invasive treatment options –, and from e-learning to skills labs and modulated training settings (14). A structured training program will encompass a better definition of training goals and skills, specialization, structured evaluation, standardization of exams and include research (8). Simulation-based training can indeed address many concerns of the old apprenticeship model, such as patient safety, efficient acquisition of complex surgical skills, overcoming the learning curve, and cost-effectiveness (4, 15). Improved structured training should include structured scheduling of activities, use of peer training, e-learning, access to simulation training on high fidelity models and/ or animals, trainee information on all available resources, effective tutoring, research, and evidence based practice learning (2, 9, 16,17).
A consensus has been reached on markers defining the quality of a surgical training program (18):
- Trainer – trainee relationship
- Operative exposure
- Supervision
- Feed back
- Structures and organization of training
- Structured teaching programs

No training is effective without assessment of the competency and proficiency achieved by the trainee. However, assessments are often perceived as haphazard, subjective and non-transparent (5, 8).
In structured simulation training programs, the most commonly used tools for objective assessment are (15):
- Technical skills assessment
- global rating scale of performance rating scores
- questionnaires and post-training surveys
- structured assessment by use of video recording
- motion tracking software.

Another established, effective and valuable tool in surgical training assessment is the *Direct Observation of Procedural Skills* (DOPS) (19, 20).
In any case, trainee assessment has to move away from the mere measure of the number of surgical procedures to mediation of competencies and skills as markers of competency (21, 22).
A consensus statement has been reached on the quality markers of training assessment (18):
- trainee feedback
- trainer feedback
- timetable structure
- trainee improvement.

However, there are also barriers to effective training assessment which we must bear in mind. These are uncertainty on what to document, concern of a negative impact on faculty popularity amongst trainees, lack of clear standards, and lack of effective remediation options (23)

According with the mission of *Urology for emerging countries* (U-merge), the authors looked at a wide array of urological training in various countries. It is notable that structured training programs do not only exist in developed countries, and old-fashioned apprenticeship models do still prevail in some developed countries although modern learning options are readily available there, albeit not implemented.
Especially but not only in the developing world, urological training is marred by inconsistency, lack of structure, and lack of focus on research and evidence-based practice (2). This is where an international and/or global training approach comes into play. More affluent countries could afford to help less fortunate countries to establish sustainable, capacity-building educational collaborations that are essential to address the global burden of global disease. International collaboration can lead the way towards competency-based training, assessment of technical skills by international standards, long-term trainer proficiency, and community-specific quality initiatives (24). Established tools for this purpose are an online curriculum, visiting educator trips, expert surgeon involvement, trainee competency tracking and identification of local outreach partners (25).
However, any collaboration towards standardized and structured training needs to be responsible, meaning responding to locally identified needs, training projects according to local contexts, and a general working towards self-sufficiency of the trainees (26).
Our results have shown a huge heterogeneity in quality urology training between countries and within continents. In systems without national structure of training it

can be assumed that such differences exist even between hospitals/training institutions. There is no doubt in times of globalization with resident and doctor migration and exchanges that training needs structure and standardization. The still huge gap in developing countries to catch up and be able to afford latest surgical and learning technologies need to be addressed with the help of responsible outreach programs.
There is ample literature on the requirements of structured training programs and assessments, and we have tried to briefly outline the key points in this paper.

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