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Understanding the Need for Simulation-Based Endourology Training for East, Central, and Southern Africa Urology Residents: A Cross-Sectional Survey Study

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Abstract

Background

Limited access to advanced endourology training in East, Central, and Southern Africa constrains residents' ability to build confidence and competence in minimally invasive procedures. Simulation based education offers a way to practice core skills outside the operating room, especially where case volumes, equipment, and faculty time are limited.

We seek to describe exposure and confidence across core endourology procedures among urology residents in East, Central, and Southern Africa, and to assess perceived need and demand for simulation-based training.

Methods

We conducted a nineteen-question, descriptive, cross sectional, web-based survey of urology residents in College of Surgeons of East, Central and Southern Africa (COSECSA) and national training programs. The survey collected demographic characteristics, self-reported exposure to seven core endourology procedures, confidence in performing each procedure, and views about simulation-based training and non-technical surgical skills. Responses were recorded on five-point Likert scales. For each procedure, we calculated mean exposure and confidence scores and derived a difference score to describe training gaps. The difference between exposure and confidence scores was used to quantify procedural training gaps. Open-ended responses were analyzed thematically to identify key training gaps and preferences for curriculum design.

Results

Seventy-nine residents completed the survey. Most respondents were male with a mean age of 32.9 years. Residents came from eight African countries, primarily Ethiopia, Zambia, and Uganda, and were most often in their third to fifth year of training. Exposure was highest for cystoscopy and ureteric (JJ) stent insertion and removal, with corresponding confidence scores that were slightly lower. In contrast, ureteroscopy (URS) and percutaneous nephrolithotomy (PCNL) had lower confidence scores despite moderate exposure, producing the largest exposure/confidence gaps. Three-quarters of respondents reported no previous simulation experience, while 97 percent expressed interest in structured endourology simulation courses.

Conclusions

Among COSECSA urology residents, exposure to core endourology procedures does not consistently translate into confidence, especially for URS and PCNL. Most residents have never participated in simulation but strongly support the introduction of structured courses. A regional, simulation-based curriculum that prioritizes procedures with the largest exposure/confidence gaps could help strengthen endourology training and expand access to safe minimally invasive care.

Introduction

Surgical education and training have historically followed the traditional Halstedian apprenticeship model, often summarized as "see one, do one, teach one.[1] This approach has shaped surgical education

for decades by allowing trainees to learn knowledge and technical skills through demonstration, repetition, real time mentorship and assistance as well as reading and didactic teaching. However, a 1999 Institute of Medicine report showed that preventable errors in hospitals were frequently linked to trainee doctors.[2] This raised concerns about patient safety and created pressure to find alternative approaches to surgical training and teaching.

In response, simulation-based training (SBT) has gained prominence. Simulation-based surgical training offers a way to reduce patient safety risks and ease stress for both mentors and trainees. It allows repeated practice in a safe and controlled environment, supports error and feedback, enables structured assessment, and provides a means of standardizing trainees' skills.[3]

Urology is one of the surgical subspecialties that has helped drive the shift toward minimally invasive surgery. [4] Results from the Urology Boot Camp in the United Kingdom show that a Urology Simulation Boot Camp is an efficient way to transfer knowledge and both technical and non-technical skills to residents, especially junior residents.[5] SBT is also pivotal in improving trainees' knowledge of equipment and their assembly and manipulation skills.[6]

Urology care in sub–Saharan Africa is among the most devoid of access to advanced technology. The surgical management of benign prostatic hyperplasia (BPH) is almost exclusively minimally invasive in high-income countries (HIC), while in sub–Saharan Africa, open prostatectomy remains the most common procedure and only a few centers perform minimally invasive surgery.[7,8] COSECSA is the largest surgical training institution in sub–Saharan Africa, operating in more than 14 East, Central and Southern Africa (ECSA) countries.[9] These countries share a common training program and examination. The COSECSA training program for Fellows of the College of Surgeons in urology consists of two years of basic surgical training followed by three years of urology. In addition to the COSECSA fellowship program, some countries have national Master of Medicine (MMed) urology training programs.

The goal of this study is to assess the need for simulation-based endourology training among urology residents in ECSA countries, including both COSECSA and national programs. This will allow us to identify, through shared input from trainees, which procedures are most in need of educational support through simulation. It is expected that these findings will assist with planning for infrastructure and training development in a way that is efficient and effective for the region.

Methods

Study design and setting:

We conducted a nineteen-question, descriptive, cross sectional, web-based survey of urology residents in College of Surgeons of East, Central and Southern Africa (COSECSA) and national training programs. The study focused on residents training in COSECSA-affiliated programs and related national urology training programs. The survey was delivered using an online form. The link was shared by email with

program directors and resident groups and circulated through existing training networks. Data collection took place in March 2025. The survey is available in the supplemental material 1 section.

Participants and recruitment:

The sampling frame consisted of 120 eligible urology residents identified through program lists and training networks. All 120 were invited to take part by email. Participation was voluntary, and there were no incentives. The initial target sample size for the study was determined to be 96 using a finite population sample size calculation:

$n_0 = \frac{Z^2 \times p \times (1-p)}{E^2}$ = 384.16, for a sample size without a population limit,

where confidence level (Z) = 95%= 1.96, proportion (p) = 0.5, and margin of error E = 0.05.

To calculate a finite population sample size, we used:

$n = \frac{n_0}{1+(n_0-\frac{1}{N})}$ = 96 participants

where N = 120, and n_0= 384.16.[10]

Residents who opened the survey first saw an information page that explained the purpose of the study, what participation involved, and how their data would be used. Those who agreed to take part proceeded to the questionnaire and could skip questions they preferred not to answer.

In total, 79 residents completed the questionnaire, giving a response rate of about two-thirds of the invited population. All completed surveys were included in the analysis.

Survey instrument:

The survey was developed in Google Forms. It was informed by previous work describing urology training in the region and by input from urologists involved in resident education and contained nineteen items grouped into sections. The research team reviewed all questions for clarity and relevance before distribution. Responses were exported into a spreadsheet for analysis. The dataset was stored in a password-protected file and was only accessible to members of the study team.

Data analysis:

Data analysis was descriptive. For categorical variables such as gender, country of training, year of residency, prior simulation exposure, and interest in simulation, we calculated counts and percentages. For the Likert scale questions, response options were coded from one to five, with higher values indicating greater exposure or greater confidence. For each of the seven procedures, we calculated the mean exposure score, mean confidence score, and a difference score equal to exposure minus confidence. The difference between exposure and confidence scores was derived to quantify procedural

training gaps. Results were summarized descriptively and visualized. Open-ended responses were read in full and grouped into common ideas about priorities for simulation, the possible role of laparoscopy, and perceived barriers and opportunities. Open-ended responses were analyzed thematically to identify key training gaps and preferences for curriculum design. Selected comments were used to illustrate the main themes.

Ethical considerations:

No identifiable information was collected, and responses were kept confidential and reported only in aggregate. Participation was voluntary, and informed consent was obtained. Participants were made to review participation and consent information before signifying their consent by checking “yes” when asked if they wish to participate. Ethical approval for the study was obtained from the Chogoria Hospital Institutional Ethics Review Committee in Kenya (approval number: CH/ISERC/A0001), and the University of California, San Francisco Institutional Review Board (approval number: 25-43659). The University of California, San Francisco served as a collaborating site for data analysis. The use of informed consent for this survey of trainees was approved by both Institutional Review Boards. Data were stored in password-protected files.

Results

Participant characteristics:

Seventy-nine urology residents completed the survey. Most respondents were male (81.3%), and the mean age was 32.9 years. Residents came from eight African countries, with the largest proportions from Ethiopia, Zambia, and Uganda. The majority were in their third, fourth, or fifth year of urology training.

Respondents represented a mix of national MMed and COSECSA fellowship tracks. Together, they provide a snapshot of mid and senior level trainees in the region’s urology workforce pipeline.

Exposure to core endourology procedures:

Residents reported higher exposure to diagnostic and lower urinary tract procedures and lower exposure to advanced stone surgery. On a five-point Likert scale, mean exposure scores were highest for cystoscopy and JJ stent insertion and removal, and lowest for PCNL.

Mean exposure scores were 4.48 for cystoscopy, 3.78 for direct vision internal urethrotomy (DVIU), 4.30 for JJ stent insertion and removal, 3.79 for transurethral resection of the prostate (TURP), 3.61 for transurethral resection of bladder tumor (TURBT), 3.59 for URS, and 3.21 for PCNL.

Confidence in performing endourology procedures:

Confidence scores followed a similar pattern but were consistently lower than exposure scores, suggesting that time in the operating room did not fully translate into comfort with independent performance.

Mean confidence scores were 4.18 for cystoscopy, 3.81 for JJ stent insertion and removal, 3.46 for DVIU, 3.23 for TURP, 3.04 for TURBT, 2.84 for URS and 2.44 for PCNL reported on a five-point Likert scale.

Exposure confidence gaps:

For each procedure, we examined the difference between mean exposure and mean confidence. The smallest gaps were seen for cystoscopy and DVIU, while URS and PCNL showed the largest differences between exposure and confidence.

Difference scores were 0.300 for cystoscopy, 0.313 for DVIU, 0.488 for JJ stent insertion and removal, 0.563 for TURP, 0.575 for TURBT, 0.750 for URS, and 0.775 for PCNL. A figure of exposure and confidence highlighted widening gaps as procedures became more complex and equipment intensive (Table 1).

Table 1
Gap between exposure and confidence for seven common endourologic procedures

Procedure	Exposure	Confidence	Gap
Cystoscopy	4.48	4.18	0.300
DVIU	3.78	3.46	0.313
JJ stent insertion and removal	4.30	3.81	0.488
TURP	3.79	3.23	0.563
TURBT	3.61	3.04	0.575
URS	3.59	2.84	0.750
PCNL	3.21	2.44	0.775

Simulation experience and interest:

Simulation exposure was limited. Seventy-five percent of residents reported no prior experience with simulation training in endourology. Despite this, interest in simulation was very high. Ninety-seven percent of respondents expressed interest in structured simulation courses, with only a small minority selecting “maybe” and none selecting “no” (Fig. 1).

Residents favored short, intensive courses and recognized the value of both technical skills practice and nontechnical skills such as team communication and situational awareness. Many viewed SBT as a necessary complement to the current training model rather than a luxury.

Qualitative comments:

Open-ended responses echoed and deepened the quantitative findings. Several residents emphasized the importance of including laparoscopy alongside endourology, noting that these procedures are infrequently available in their home institutions. Others stressed that simulation should become an integral part of the urology curriculum rather than a one-off workshop.

Comments included statements such as that laparoscopic surgeries should be included in simulation training because these procedures are not routine in some countries, that endourology teaching should be simulation supported, and that such training would be very important for residents in urology. These remarks illustrate both enthusiasm for simulation and a clear expectation that it should address gaps in access to complex minimally invasive procedures.

Discussion

The management of urolithiasis depends on multiple factors, including patient factors such as obesity, anatomy, solitary kidney, and age; stone factors such as type, location, and number; the availability of skilled experts; and available equipment. In HICs, minimally invasive procedures such as percutaneous nephrolithotomy, ureteroscopy, retrograde intrarenal surgery (RIRS), and extracorporeal shock wave lithotripsy (ESWL) are the procedures of choice. In contrast, in sub–Saharan Africa, open stone surgery is still very common.[11,12] In this region, only a few centers can offer these minimally invasive procedures. Limitations to urology care in sub–Saharan Africa are multifactorial and include socioeconomic barriers, lack of equipment, a shortage of urologists, and knowledge and skill gaps among practicing urologists.[13]

Formal urology training started relatively late in sub–Saharan Africa and initially required completion of a MMed in general surgery before urology training.[14] There are now MMed urology residency programs and fellowships that follow MMed general surgery. These programs face many challenges, including limited exposure to advanced and minimally invasive procedures, few and underused simulation centers, a small pool of trainers, lack of equipment for practice, and unstructured curricula.[15] A few institution-based urological SBT initiatives have been conducted in sub–Saharan Africa and have shown success.[16–18] However, most training centers still send trainees abroad, where the exposure and skills acquired are often not sufficient to start and sustain services on return.[19] Skill gaps persist and there is reliance on mentoring from HIC urologists[19]. A study from Nigeria on the types of services provided by urologists found that most urologists were not able to perform many endourologic procedures.[20]

Across all endourological procedures surveyed, our data reveal a consistent discrepancy between residents' exposure and confidence, underscoring a critical training need within COSECSA's regional urology programs.[6]The highest exposure and confidence were reported for cystoscopy (4.48 vs. 4.18) and JJ stent insertion and removal (4.30 vs. 3.81), procedures more commonly available even in resource-limited training settings.[7] In contrast, URS and PCNL—both technically demanding and equipment-intensive—showed the lowest confidence scores (2.84 and 2.44, respectively) despite

moderate exposure (3.59 and 3.21). This research suggests that the widening exposure-confidence gap reflects the paucity of structured, hands-on opportunities to practice advanced endourologic skills safely and repeatedly.[8] Historically, urology training in sub-Saharan Africa has relied on a Halstedian apprenticeship model, offering limited access to minimally invasive procedures and few opportunities for standardized skill acquisition outside the operating room.[11] These findings highlight the need for SBT to bridge this gap—particularly for URS and PCNL—by providing an equitable platform to develop competence and confidence before independent clinical practice.

SBT can potentially benefit surgical training in COSECSA. It has been shown to increase confidence, post-training satisfaction, and objective skills examinations.[21] SBT's utility is seen throughout the broader surgical field. A study of oral and maxillofacial surgery training demonstrated that those trained using simulation were better able to identify which instruments to use and showed more comfort in each step of a procedure.[22] Further, SBT improved glaucoma surgical competence and confidence amongst trainee ophthalmologist in the GLASS trial.[23] Bedada et al. demonstrated that surgical training using SBT can be administered by peers and near-peers while maintaining its benefits.[24] Within the COSECSA region, surgical residents have shown their interests in incorporating SBT into training, with one study citing 73% of residents surveyed wishing to integrate SBT into curricula.[25]

Despite the high willingness to use SBT in urologic education, feasibility of implementation remains contentious in several South and Eastern African nations. Many barriers have been described, including cost and weak implementation plans.[26–28] Such barriers can delay training and keep exposure to common urologic procedures below what is needed for competence. Our study indicates that SBT models can work and increase trainees' confidence with common endourologic procedures; however, the training centers in this study still face barriers such as cost, lack of equipment, and the absence of standardized curricula. These challenges are pronounced in low- and middle-income countries, including COSECSA member countries, where infrastructure and training systems are not currently optimized to treat the population. [29] This is especially important given the frequency with which endourologic procedures use minimally invasive approaches. Minimally invasive procedures have been demonstrated to be safe, and not more expensive than traditional approaches.[30,31] Trainees must achieve competence in these modalities, and low-cost SBT can help bridge this gap, but it must be implemented in ways that are useful and reproducible across the region.

There are practical paths to feasibility. One of the most common barriers, cost, can be mitigated through partnerships with technology companies, research grants, and the adoption of cost-effective models.[26] Crucially, the models used need not be the most expensive to be effective: high-validity, low-cost approaches, such as video-based instruction using everyday materials as task mimics and 3D-printed anatomic models, have demonstrated validity as simulation methods that can offset high costs and limited access to advanced simulators while still supporting rigorous training.[32,33] Training must first, however, be augmented to implement SBT technologies. With respect to training curricula, the relative novelty of SBT for endourologic procedures in the region presents an opportunity to design standardized

training from the outset, incorporating SBT earlier and through all levels of urologic training. Despite the barriers, a well-designed, rigorous SBT program can be implemented.

This study has several limitations. First, the survey relied on voluntary response and email distribution, so the sampling frame is not fully defined. In addition, we obtained 79 responses out of a target of 96 based on the correction for a finite sample size calculation. The study's small sample size does not ensure that the findings can be applied beyond those surveyed. Further, participating residents may differ from non-respondents in motivation, training environment, or interest in simulation. Second, all data were self-reported. Likert scale ratings of exposure and confidence are subject to recall and social desirability bias and do not replace objective assessments of operative performance. However, the consistent patterns across procedures and the alignment between quantitative results and qualitative comments increase confidence in the overall findings.

Conclusion

Urology residents in East, Central, and Southern Africa report substantial exposure to basic endourology procedures but limited confidence in advanced stone surgery, particularly URS and PCNL. Most have never participated in simulation, yet nearly all express strong interest in structured SBT, demonstrating that it may be a safe and feasible method to increase exposure and confidence to these procedures.

Future studies regarding SBT's effects in COSECSA endourologic training, surgical preparation, and outcomes are needed. These findings support the development of a regional simulation curriculum that focuses on procedures with the greatest exposure-confidence gaps and incorporates both technical and nontechnical skills. Interventions include increasing collaboration between COSECSA, national training programs, and partner institutions to translate this vision into practical training opportunities, strengthen the endourology skill set of future urologists, and improve access to safe minimally invasive care across the region.

Abbreviations

COSECSA: College of Surgeons of East, Central, and Southern Africa

MMed: Master of Medicine

URS: Ureteroscopy

PCNL: Percutaneous nephrolithotomy

SBT: Simulation-based training

BPH: Benign prostatic hypertrophy

HIC: High-income countries

ECSA: East, Central, and Southern Africa countries

TURP: Transurethral resection of the prostate

TURBT: Transurethral resection of bladder tumor

DVIU: Direct vision internal lithotomy

RIRS: Retrograde intrarenal surgery

ESWL: Extracorporeal shock wave lithotripsy

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Figures

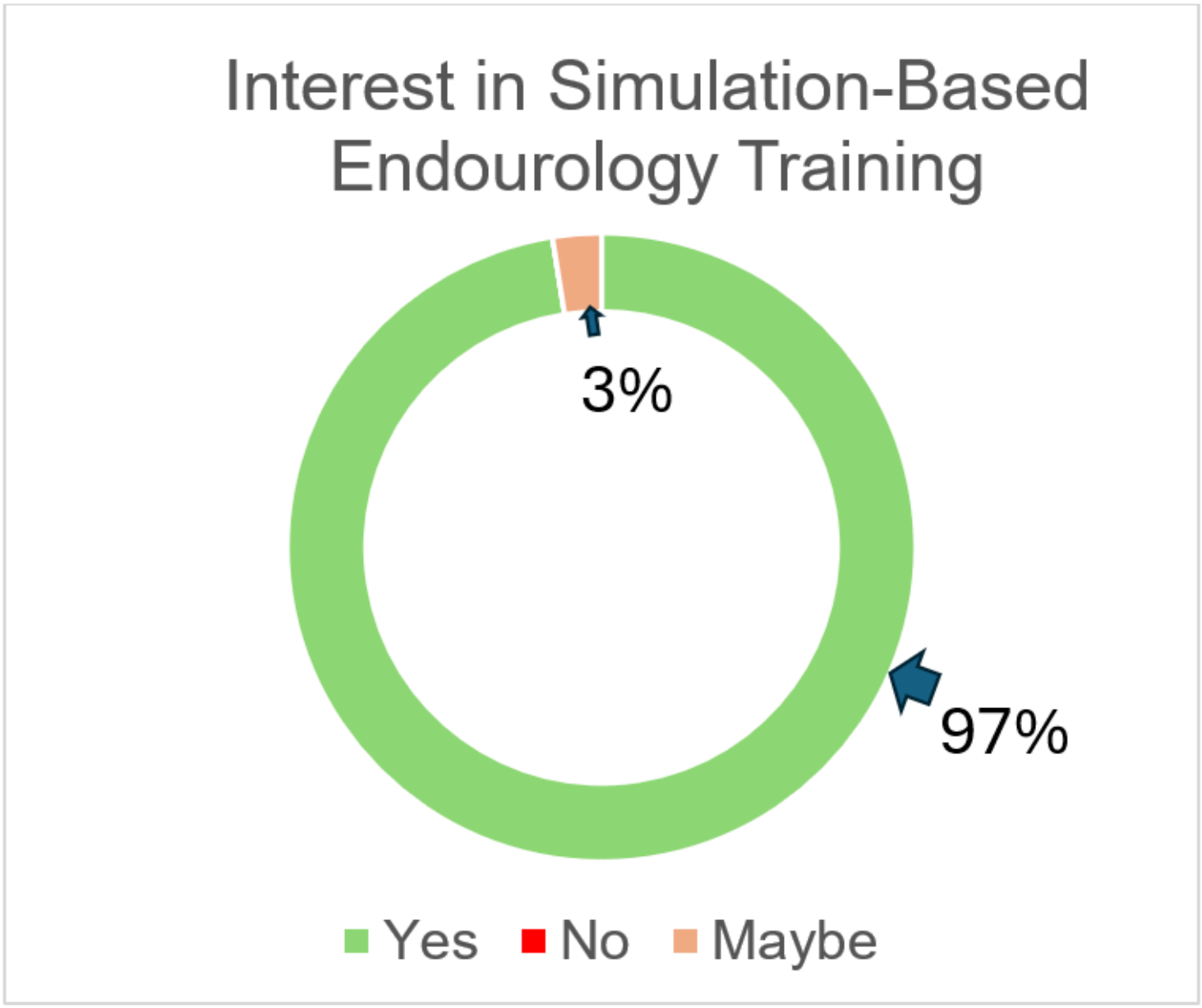


Figure 1

Interests for SBT amongst the surveyed participants

Supplementary Files

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- SupplementalMaterialSBTPaper9.11.26.docx