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ESRU-ESU-YAU_UROTECH Survey on Urology Residents Surgical Training: Are We Ready for Simulation and a Standardized Program?

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Abstract

Background: Currently, the landscape of surgical training is undergoing rapid evolution, marked by the initial implementation of standardized surgical training programs, which are further facilitated by the emergence of new technologies. However, this proliferation is uneven across various countries and hospitals.
Objective: To offer a comprehensive overview of the existing surgical training programs throughout Europe, with a specific focus on the accessibility of simulation resources and standardized surgical programs.
Design, setting, and participants: A dedicated survey was designed and spread in May 2022 via the European Association of Urology (EAU) mail list, to Young Urologist Office (YUO), Junior membership, European Urology Residents Education Program participants between 2014 and 2022, and other urologists under 40 yr, and via the EAU Newsletter.
Intervention: A 64-item, online-based survey in accordance with the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) using the platform of Survey Monkey (Portland, OR, USA) was realized.

[†] EAU Young Urologists Collaborators (listed in the Supplementary material): all the responders to the survey attained a collaborative authorship according to the recommendation of the International Committee of Medical Journal Editors.
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Outcome measurements and statistical analysis: The study involved an assessment of the demographic characteristics. Additionally, it explored the type of center, availability of various surgical approaches, presence of training infrastructure, participation in courses, organization of training, and participants' satisfaction with the training program. The level of satisfaction was evaluated using a Likert-5 scale. The subsequent sections delved into surgical training within the realms of open, laparoscopic, robotic, and endoscopic surgery, each explored separately. Finally, the investigation encompassed the presence of a structured training course and the availability of a duly validated final evaluation process.

Results and limitations: There were 375 responders with a completion rate of 82%. Among them, 75% were identified as male, 50.6% were young urologists, 31.7% were senior residents, and 17.6% were junior residents. A significant majority of participants (69.6%) were affiliated with academic centers. Regarding the presence of dry lab training facilities, only 50.3% of respondents indicated its availability. Among these centers, 46.7% were primarily focused on laparoscopy training. The availability of virtual and wet lab training centers was even more limited, with rates of 31.5% and 16.2%, respectively. Direct patient involvement was reported in 80.5% of cases for open surgery, 58.8% for laparoscopy, 25.0% for robotics, and 78.6% for endourology. It is worth noting that in <25% of instances, training followed a well-defined standardized program comprising both preclinical and clinical modular phases. Finally, the analysis of participant feedback showed that 49.7% of respondents expressed a satisfaction rating of either 4 or 5 points with respect to the training program. The limitations of our study include the low response rate, predominance of participants from academic centers, and absence of responses from individuals not affiliated with the EAU network.

Conclusions: The current distribution of surgical training centers falls short of ensuring widespread access to standardized training programs. Although dry lab facilities are relatively well spread, the availability of wet lab resources remains restricted. Additionally, it appears that many trainees' initial exposure to surgery occurs directly with patients. There is a pressing need for continued endeavors to establish uniform training routes and assessment techniques across various surgical methodologies.

Patient summary: Nowadays, the surgical training landscape is heterogeneous across different countries. The implementation of a standardized training methodology to enhance the overall quality of surgical training and thereby improving patient outcomes is needed.

1. Introduction

In the Association of American Medical Colleges 2021 report, the number of active residents is >144 000, and among them >1700 are urology residents [1]. Although urology residency programs in Europe can vary in what they cover and how they are organized, it is clear that many young doctors work in operating rooms every day. Consequently, the significance of their training is of outmost importance for optimal patient care.

A Food and Drug Administration (FDA) study reported >10 000 adverse events in robotic procedures between 2000 and 2013 in the USA, considering different surgical specialties [2]. Hence, there is a strong need for the creation of well-organized, standardized, validated, and effective training plans, in order to reduce the potential risk of intra- and postoperative adverse events. In this view, considering the available tools and the potential advantages provided by the integration of technology and three-dimensional (3D) simulation in the current surgical training [3], the dogma "see one, do one, teach one" is no more sustainable.

Previously published surveys showed how the surgical exposure or exposure to surgical simulators of urology residents is low [4], especially during the recent COVID-19 pandemic [5,6]. However, nowadays, new digital and technological instruments are available to support their learning process [7]. Furthermore, in the past years, many centers and societies, such as the European School of Urology (ESU) and the European Robotic Urology Section (ERUS), have developed a standardized training pathway for specific procedures, aiming to reduce the current surgical learning curves for trainees and the potential perioperative risks for patients [8,9].

However, the scenario is still heterogeneous across the European (EU) countries, and moreover, the development of standardized training curricula for open, laparoscopic, robot-assisted, and endoscopic surgery in some ways is still an unmet need.

Our aim is to provide a comprehensive overview of the current surgical training programs across Europe, focusing on the availability of simulation and standardized surgical programs.

2. Patients and methods

2.1. Study design

We developed a 64-item, online-based survey in accordance with the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) [10], using the platform http://www.surveymonkey.com (Survey Monkey, Portland, OR, USA).

The survey was spread in May 2022 via the European Association of Urology (EAU) mail list, to Young Urologist Office (YUO), Junior membership, European Urology Residents Education Program (EUREP) participants between 2014 and 2022, and to other urologists under 40 yr.

Furthermore, a QR code with a survey link was shown during the UroTech meeting in Istanbul. The last reminder via the EAU newsletter was sent at the end of May 2022.

Baseline characteristics assessed were the following: gender, position (junior resident, senior resident, and young urologist), type of center, type of surgical approaches available in their center, presence of training infrastructure, participation in courses, how the training was organized, and satisfaction with the training program. The level of satisfaction was assessed using a Likert-5 scale.

Then, four different specific sections explored the surgical training in open, laparoscopic, robotic, and endoscopic surgery. In particular, the survey assessed how the training was performed (directly on patients or on animal, virtual, and 3D printed models) as well as the availability of theoretical preparation before the surgical performance on patients. Finally, the presence of a structured training course and the availability of a final validated evaluation were investigated.

2.2. Statistical analysis

Statistical analyses were performed and reported following the established guidelines [11]. Descriptive statistics are reported as the median and interquartile range for continuous variables, and as the frequency and proportion for categorical variables, as appropriate.

Differences in baseline characteristics between EU and non-EU participants were evaluated by the Pearson chi-square and Mann-Whitney U tests, as appropriate. The same tests were used to explore potential differences regarding the open, laparoscopic, robotic, and endoscopic training among study cohorts.

The analyses were performed using IBM SPSS statistics (version 28.0.1.0). All tests were two sided, with a significance level set at $p < 0.05$.

3. Results

3.1. Baseline characteristics

A total of 375 responders begun the survey, with a completion rate of 82% (308/375; Table 1). Of them, 229 (75%) were male; 155 (50.3%), 97 (31.5%), and 56 (17.6%) were young urologists, senior residents, and junior residents, respectively. Most participants worked in academic centers (215 responders, 69.6%), covering 25 different countries. Of these doctors, 225 (73%) performed their training in Europe. The countries with the highest number of participants were Italy (48, 15.5%) and Spain (33, 10.7%).

In all, 308 (100%), 278 (90.3%), 142 (46.1%), and 307 (99.7%) were revealed to have access to open, laparoscopic, robotic, and endoscopic surgery at their centers. Of the responders, 155 (50.3%) had the possibility to use a dry lab (46.7% laparoscopy). On the other side, only 50 (16.2%) participants had access to a wet lab (14.3% laparoscopy): in particular, ten (3.2%), 33 (10.7%), and seven (2.3%) had access to a cadaver lab, an animal lab, and both, respectively. A virtual lab was available in 97 (31.5%), especially for robotics (20.1%) and laparoscopy (17.2%).

After evaluating the surgical training pathway, 280 (90.9%) had the possibility to participate in any practical courses. Among them, 100 (32.5%) benefitted from EAU/ESU activities and 128 (41.6%) participated in any official examination such as the European training in Basic Laparoscopic Urological Skills (EBLUS), Endoscopic Stone Treatment (EST), or others. A total of 128 (41.6%) were referred to have an evaluation of their nontechnical skills. In 136 (44.2%) cases, the training course was independently organized by the trainees, and only in 66 (21.4%), the training was certified.

Lastly, focusing on overall satisfaction of surgical training, 153 (49.7%) revealed to be satisfied or very satisfied (Fig. 1).

3.2. Open surgery

Focusing on open surgery (Table 2), patient-based training resulted to be most diffused (80.5%), with 67.2% (207 responses) responders dedicating at least 5 h/wk for the training. While 65.3% of the time, hands-on patient training is favored, almost all cases (99.2%) involved a tutor-guided, theory-based preparation before the actual procedure. However, only 22.1% confirmed a post-training evaluation, and <10% conducted a formal assessment using standardized metrics and methods.

3.3. Laparoscopic surgery

Regarding laparoscopy (Table 3), while the primary training method remains "directly on patients" (58.8%), we observed that 22.4%, 20.5%, and 38.5% of respondents had access to animal, virtual, and printed simulators for practice, respectively. The most common approach involved performing surgical tasks step by step (61.4%), followed by standardized exercises (38.6%). Notably, the majority of cases (80.2%) did not include an evaluation of the training.

3.4. Robotic surgery

For robotic surgery (Table 4), virtual simulators emerged as the primary training method (31.5%), followed by directly on patients (25.0%), often under the guidance of an expert (48.1%). The step-by-step execution of surgical tasks (33.1%) and standardized exercises (25.0%) were the favored approaches. However, the training was not evaluated in a significant percentage of instances (85.7%), with a final assessment notably being absent in 82.8% of responses.

Table 1 – Demographic data and general questions on training facilities

		Overall (N = 308)	Non-EU doctors (N = 83)	EU doctors (N = 225)	p value
Age (yr), median (IQR)		33 (30–36)	34 (32–36)	32 (29–36)	<0.01
Male gender, n (%)		229 (74.4)	74 (89.2)	155 (68.9)	<0.01
Position	Junior resident, n (%)	56 (17.6)	5 (6)	51 (22.7)	<0.01
	Senior resident, n (%)	97 (31.7)	24 (28.9)	73 (32.4)	
	Young urologist (<40 yr old), n (%)	155 (50.7)	54 (65.1)	101 (44.9)	
Number of years of practice, median (IQR)		4 (2–6)	4 (2–6)	4 (2–6)	0.5
Type of hospital	Academic hospital, n (%)	215 (69.6)	60 (71.6)	155 (68.9)	<0.01
	Teaching peripheral hospital, n (%)	57 (18.6)	8 (9.9)	49 (21.8)	
	Rural hospital, n (%)	12 (3.9)	2 (2.5)	10 (4.4)	
	Private practice, n (%)	16 (5.2)	10 (12.3)	6 (2.7)	
	Other, n (%)	8 (2.6)	3 (3.7)	5 (2.2)	
Which of the following surgical approaches are available at your hospital? You can choose multiple answers.	Open, n (%)	308 (100)	83 (100)	225 (100)	/
	Laparoscopy, n (%)	278 (90.3)	76 (91.6)	202 (89.8)	0.6
	Robotics, n (%)	142 (46.1)	24 (28.9)	118 (52.4)	<0.01
	Endoscopy, n (%)	307 (99.7)	82 (98.8)	225 (100)	0.10
Does your hospital have a training center with a dry lab?	Yes, n (%)	155 (50.3)	41 (49.4)	114 (50.7)	0.8
	For open surgery (N = 155), n (%)	37 (23.9)	14 (34.1)	23 (20.2)	0.07
	For laparoscopic surgery (N = 155), n (%)	144 (92.9)	38 (92.7)	106 (93)	0.9
	For robotic surgery (N = 155), n (%)	58 (37.4)	10 (24.4)	48 (42.1)	0.04
	For endoscopic surgery (N = 155), n (%)	30 (19.4)	8 (19.5)	22 (19.3)	0.9
Does your hospital have a training center with a wet lab?	Yes, n (%)	50 (16.2)	19 (22.9)	31 (13.8)	0.06
	For open surgery (N = 50), n (%)	29 (58)	12 (63.2)	17 (54.8)	0.5
	For laparoscopic surgery (N = 50), n (%)	44 (88)	15 (78.9)	29 (93.5)	0.1
	For robotic surgery (N = 50), n (%)	9 (18)	0 (0)	9 (29)	<0.01
	For endoscopic surgery (N = 50), n (%)	9 (18)	4 (21.1)	5 (16.1)	0.7
If you answered "yes" in the previous question, what type of wet lab does your hospital have?	Cadaver lab (N = 50), n (%)	10 (20)	5 (26.3)	5 (16.1)	0.4
	Animal lab (N = 50), n (%)	33 (66)	12 (63.1)	21 (67.7)	
	Both (N = 50), n (%)	7 (14)	2 (10.5)	5 (16.2)	
Does your hospital have a training center with a virtual lab?	Yes, n (%)	97 (31.5)	25 (30.1)	72 (32)	0.7
	For open surgery (N = 97), n (%)	11 (11.3)	4 (16)	7 (9.7)	0.4
	For laparoscopic surgery (N = 97), n (%)	53 (54.6)	15 (60)	38 (52.8)	0.5
	For robotic surgery (N = 97), n (%)	62 (63.9)	10 (40)	52 (72.2)	<0.01
	For endoscopic surgery (N = 97), n (%)	21 (21.6)	6 (24)	15 (20.8)	0.7
During your residency, did you participate in any of the in practical courses? You can choose multiple answers.	Yes, n (%)	280 (90.9)	74 (89.2)	206 (91.6)	0.5
	For open surgery (N = 280), n (%)	113 (40.4)	39 (52.7)	74 (35.9)	0.01
	For laparoscopic surgery (N = 280), n (%)	234 (83.6)	60 (81.1)	174 (84.5)	0.5
	For robotic surgery (N = 280), n (%)	106 (37.9)	27 (36.5)	79 (38.3)	0.8
	For endoscopic surgery (N = 280), n (%)	188 (67.1)	53 (71.6)	135 (65.5)	0.3
During your residency, did you participate in any official examinations? You can choose multiple answers.	Yes, n (%)	129 (41.9)	35 (42.2)	94 (41.8)	0.9
	EBLUS, n (%)	76 (24.6)	10 (12)	66 (29.3)	
	EST, n (%)	25 (8.1)	4 (4.8)	21 (9.3)	
	EBRUST, n (%)	4 (1.3)	2 (2.4)	2 (0.8)	
	Others, n (%)	67 (21.7)	26 (31.3)	41 (18.2)	
Have you ever been trained and evaluated for nontechnical skills (eg, decision-making, emergency scenario, team training, etc.)?	Yes, n (%)	128 (41.6)	44 (53)	84 (37.3)	0.01
Please rate your level of satisfaction with your surgical training.	Very dissatisfied, n (%)	9 (2.9)	2 (2.4)	7 (3.1)	0.2
	Dissatisfied, n (%)	54 (17.5)	11 (13.3)	43 (19.1)	
	Neither dissatisfied nor satisfied, n (%)	92 (29.9)	19 (22.9)	73 (32.4)	
	Satisfied, n (%)	135 (43.8)	45 (54.2)	90 (40)	
	Very satisfied, n (%)	18 (5.8)	6 (7.2)	12 (5.3)	

(continued on next page)

Table 1 (*continued*)

		Overall (*N* = 308)	Non-EU doctors (*N* = 83)	EU doctors (*N* = 225)	*p* value
Is your training course independently organized by trainees with a senior urologist leading the course?	Yes, *n* (%)	136 (44.2)	49 (59)	87 (38.7)	<0.01
If you have answered "yes" in the previous question, was the training certified?	Yes (*N* = 136), *n* (%)	66 (48.5)	31 (63.3)	35 (40.2)	0.04
	NA (*N* = 136), *n* (%)	16 (11.8)	4 (8.2)	12 (13.8)	
Were there video recording tools and/or methods used in documenting a trainee's performance?	Yes, *n* (%)	75 (24.4)	21 (25.3)	54 (24)	0.3
	NA, *n* (%)	12 (3.9)	1 (1.2)	11 (4.9)	
Are you aware of the training activities provided by EAU/ESU, and if yes, have you participated in or benefitted from the training activities provided by EAU/ESU?	No, I'm not aware, *n* (%)	64 (20.8)	22 (26.5)	42 (18.7)	0.1
	Yes, I'm aware, but I've never participated or benefitted, *n* (%)	144 (46.8)	41 (49.4)	103 (45.8)	
	Yes, I'm aware, and I've participated and benefitted, *n* (%)	100 (32.5)	20 (24.1)	80 (35.6)	

EAU = European Association of Urology; EBLUS = European training in Basic Laparoscopic Urological Skills; EST = Endoscopic Stone Treatment; ESU = European School of Urology; EU = European; IQR = interquartile range; NA = not applicable.

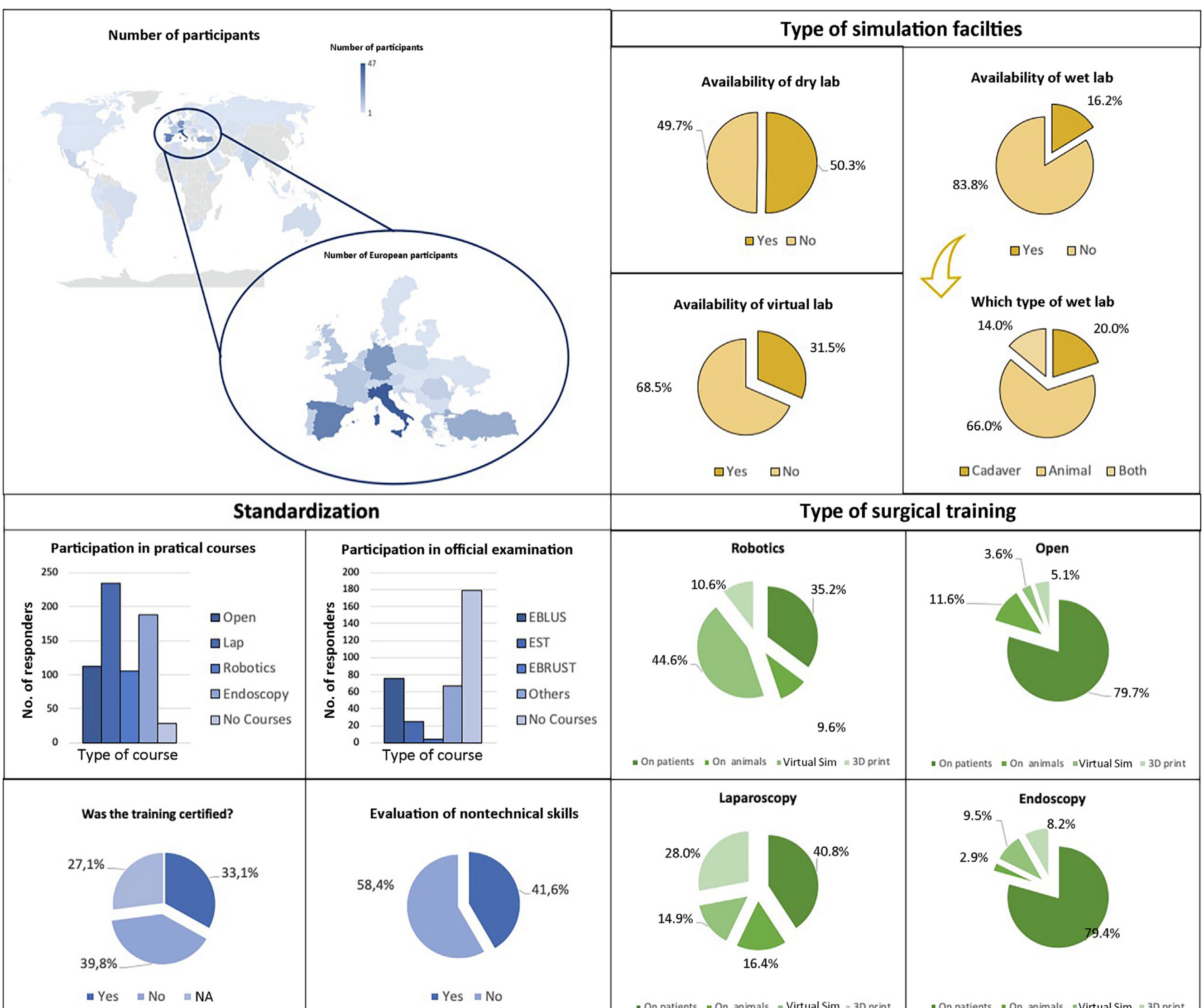

Fig. 1 – Graphical overview of the main participants' answers to the survey. 3D = three dimensional; EBLUS = European training in Basic Laparoscopic Urological Skills; EST = Endoscopic Stone Treatment; Lap = laparoscopic; NA = not applicable; Sim = simulation.

Table 2 – Responses to open surgery questions

Open surgery		Overall (N = 308)	Non-EU doctors (N = 83)	EU doctors (N = 225)	p value
How many hours per week are dedicated to training in open surgery?	<1 h, n (%)	116 (37.7)	5 (6)	111 (49.3)	<0.01
	1–5 h, n (%)	91 (29.5)	31 (37.3)	60 (26.7)	
	5–10 h, n (%)	34 (11)	20 (24.1)	14 (6.2)	
	>10 h, n (%)	30 (9.7)	18 (21.7)	12 (5.3)	
	NA, n (%)	37 (12)	9 (10.8)	28 (12.4)	
What types of training in open surgery did you have? (N21) If you have none, please move on to the next topic	Directly on patients, n (%)	248 (80.5)	74 (89.2)	174 (77.3)	0.02
	Animal models, n (%)	36 (11.7)	9 (10.8)	27 (12)	0.7
	Virtual simulators, n (%)	11 (3.6)	3 (3.6)	8 (3.6)	0.9
	3D printed or other simulators, n (%)	16 (5.2)	7 (8.4)	9 (4.0)	0.11
If you answered “directly on patients” in the question N21, does the patient know that the resident/trainee is operating on him/her?	Yes (N = 248), n (%)	150 (60.5)	56 (75.7)	94 (54)	<0.01
If you answered “directly on patients” in the question N21, was the operation initially performed under the supervision of a senior resident or a consultant?	Yes (N = 248), n (%)	246 (99.2)	73 (98.6)	173 (99.4)	0.5
If you answered “directly on patients” in the question N21, is there a theoretical preparation for the specific task before the practical performance?	Yes (N = 248), n (%)	162 (65.3)	56 (75.7)	106 (60.9)	0.02
If you answered “directly on patients” in the question N21, is there an objective evaluation of this theoretical preparation?	Yes (N = 248), n (%)	63 (25.4)	26 (35.1)	37 (21.3)	0.02
How was your training carried out? You can choose multiple answers.	Execution of surgical tasks step by step, n (%)	221 (71.8)	64 (77.1)	157 (69.8)	0.21
	Standardized exercises, n (%)	68 (22.1)	25 (30.1)	43 (19.1)	0.04
	Simulation of the intervention, n (%)	30 (9.7)	8 (9.6)	22 (9.8)	0.9
	Well-defined standardized training program with preclinical and clinical modular training, n (%)	17 (5.5)	8 (9.6)	9 (4.0)	0.061
How was your training evaluated?	It was not evaluated, n (%)	240 (77.9)	52 (62.7)	188 (83.6)	<0.01
	It was evaluated with a Likert scale (ie, from 1 to 10), n (%)	39 (12.7)	18 (21.7)	21 (9.3)	
	It was evaluated with standardized metrics with specifically defined objectives, n (%)	29 (9.4)	13 (15.7)	16 (7.1)	
At the end of your training, how was the final assessment carried out?	There was no final assessment, n (%)	195 (63.3)	41 (49.4)	154 (68.4)	<0.01
	Self-assessment by the trainees, n (%)	82 (26.6)	23 (27.7)	59 (26.2)	
	Performed by the training company, n (%)	31 (10.1)	19 (22.9)	12 (5.3)	

3D = three dimensional; EU = European; NA = not applicable.

3.5. *Endoscopic surgery*

Lastly, focusing on endoscopy (Table 5), it is notable that the time allocated to training increased, with 37.3% of respondents dedicating over 5 h/wk. The predominant training method remains hands-on patient experience, chosen in 78.6% of cases. Surgical task execution was undertaken in 70.1%, standardized exercises in 20.5%, and intervention simulation in 13.3% of cases. Evaluations using a Likert scale and metrics were conducted in only 10.4% and 7.8% of instances, respectively.

3.6. *Comparison between EU and non-EU participants*

Comparing EU and non-EU respondents, those from Europe were younger (32 vs 34 yr old, p < 0.01) and with fewer male patients (68.9% vs 89.2%, p < 0.01). In addition, within the EU participants, a smaller percentage of young urologists (as opposed to residents) were observed (44.9% vs 65.1%, p < 0.01).

The surgical approaches available to doctors in their respective training centers were largely comparable for both EU and non-EU participants, with one exception: EU doctors reported greater availability of robotic surgery (52.4% vs 28.9%, p < 0.01) at their centers. Interestingly, among non-EU doctors, a notably larger portion of participants mentioned being trained and evaluated for nontechnical skills (53% vs 37.3%, p = 0.01). Analyzing the results pertaining to open surgery, it was observed that a greater proportion of non-EU doctors dedicated over 5 h/wk to training in this field than their EU counterparts (45.8% vs 11.5%, p < 0.01). In comparison with the EU doctors, the non-EU responders were more likely to undergo direct patient training (75.7% vs 54%, p = 0.02; Fig. 2), and patients were also more frequently informed about the expertise of the lead operator (75.7% vs 54%, p < 0.01; Fig. 2). Furthermore, non-EU doctors reported receiving more theoretical preparation for specific tasks prior to surgical performance (75.7% vs 60.9%, p = 0.02), and they also underwent objective evaluations of such theoretical preparation more often (35.1% vs 21.3%, p = 0.02). The laparoscopic training approach was similar between EU and non-EU participants, with no significant differences on the topics explored.

Focusing on robotics, a smaller proportion of non-EU doctors were trained through standardized exercises

Table 3 – Responses to laparoscopic surgery questions

Laparoscopic surgery		Overall (*N* = 308)	Non-EU doctors (*N* = 83)	EU doctors (*N* = 225)	*p* value
How many hours per week are dedicated to training in laparoscopic surgery?	<1 h, *n* (%)	116 (37.7)	24 (28.9)	92 (40.9)	<0.01
	1–5 h, *n* (%)	109 (35.4)	38 (45.8)	71 (31.6)	
	5–10 h, *n* (%)	19 (6.2)	6 (7.2)	13 (5.8)	
	>10 h, *n* (%)	13 (4.2)	3 (3.6)	10 (4.4)	
	NA, *n* (%)	51 (16.6)	12 (14.5)	39 (17.3)	
What types of training in laparoscopic surgery did you have? (N32) If you have none, please move on to the next topic	Directly on patients, *n* (%)	181 (58.8)	55 (66.3)	126 (56)	0.11
	Animal models, *n* (%)	69 (22.4)	18 (21.7)	51 (22.7)	0.8
	Virtual simulators, *n* (%)	63 (20.5)	14 (16.9)	49 (21.8)	0.3
	3D printed or other simulators, *n* (%)	118 (38.3)	26 (31.1)	92 (40.9)	0.13
If you answered "directly on patients" in the question N32, does the patient know that the resident/trainee is operating on him/her?	Yes (*N* = 181), *n* (%)	109 (60.2)	40 (72.7)	69 (54.8)	0.02
If you answered "directly on patients" in the question N32, was the operation initially performed under the supervision of a senior resident or a consultant?	Yes (*N* = 181), *n* (%)	179 (98.9)	54 (98.2)	125 (99.2)	0.5
If you answered "directly on patients" in the question N32, is there a theoretical preparation for the specific task before the practical performance?	Yes (*N* = 181), *n* (%)	117 (64.6)	41 (74.5)	76 (60.3)	0.07
If you answered "directly on patients" in the question N32, is there an objective evaluation of this theoretical preparation?	Yes (*N* = 181), *n* (%)	46 (25.4)	16 (29.1)	30 (23.8)	0.4
How was your training carried out? You can choose multiple answers.	Execution of surgical tasks step by step, *n* (%)	189 (61.4)	53 (63.9)	136 (60.4)	0.6
	Standardized exercises, *n* (%)	119 (38.6)	32 (38.6)	87 (38.7)	0.9
	Simulation of the intervention, *n* (%)	50 (16.2)	12 (14.5)	38 (16.9)	0.6
	Well-defined standardized training program with preclinical and clinical modular training, *n* (%)	31 (10.1)	10 (12)	21 (9.3)	0.5
How was your training evaluated?	It was not evaluated, *n* (%)	247 (80.2)	64 (77.1)	183 (81.3)	0.11
	It was evaluated with a Likert scale (ie, from 1 to 10), *n* (%)	28 (9.1)	12 (14.5)	16 (7.1)	
	It was evaluated with standardized metrics with specifically defined objectives, *n* (%)	33 (10.7)	7 (8.4)	26 (11.6)	
At the end of your training, how was the final assessment carried out?	There was no final assessment, *n* (%)	210 (68.2)	53 (63.9)	157 (69.8)	0.11
	Self-assessment by the trainees, *n* (%)	59 (19.2)	14 (16.9)	45 (20)	
	Performed by the training company, *n* (%)	39 (12.7)	16 (19.3)	23 (10.2)	

3D = three dimensional; EU = European; NA = not applicable.

(15.7% vs 28.4%, $p = 0.02$) and a well-defined standardized training pathway including preclinical and clinical modular training (3.6% vs 12%, $p = 0.03$).

Lastly, in the context of endoscopy, it was noted that a greater proportion of non-EU doctors spent >5 h/wk in training for endoscopic surgery than their EU counterparts (62.6% vs 28%, $p < 0.01$). A higher proportion of non-EU responders were reported to be trained directly on patients than EU doctors (77.5% vs 56.7%, $p < 0.01$). However, a higher proportion of non-EU participants underwent an objective evaluation of theoretical preparation (46.5% vs 22.8%, $p < 0.01$).

4. Discussion

Here, we provide an updated snapshot of the current state of surgical training for residents and young urologists worldwide, with a particular focus on Europe. We observe a slightly promising shift toward simulation-based training for laparoscopy and robotics. However, traditional patient-based training continues to be the predominant approach for open surgery and endoscopy. Additionally, access to standardized programs and examinations remains limited.

The study is based on an online survey distributed among urologists across Europe, targeting young urologists under the age of 40 yr and residents. The survey was spread through important and representative channels such as the EAU mailing list, YUO, and EUREP.

We recorded a notable gender difference, with 75% of the respondents being males. Similar findings had already been highlighted by other authors. Zaza et al. [12] emphasized how, in the surgical field, a lack of adequate role models is one of the main reported reasons why women drop out of surgical programs. They also reported that women represent only 20% of practicing surgeons and 7.3% of full professors of surgery. These data indirectly emphasize the ongoing efforts required to attain gender equality within the fields of general surgery and urology, even in the present era. There remains a substantial journey ahead to address this imbalance. Half of the respondents are urologists who have completed their training within the residency program. Consequently, our data predominantly

Table 4 – Responses to robotic surgery questions

Robotic surgery		Overall (N = 308)	Non-EU doctors (N = 83)	EU doctors (N = 225)	p value
How many hours per week are dedicated to training in robotic surgery?	<1 h, n (%)	181 (58.8)	48 (57.8)	133 (59.1)	0.6
	1–5 h, n (%)	45 (14.6)	12 (14.5)	33 (14.7)	
	5–10 h, n (%)	10 (3.2)	1 (1.2)	9 (4.0)	
	>10 h, n (%)	4 (1.3)	2 (2.4)	2 (0.9)	
	NA, n (%)	68 (22.1)	20 (24.1)	48 (21.3)	
What types of training in robotic surgery did you have? (N43) If you have none, please move on to the next topic	Directly on patients, n (%)	77 (25)	15 (18.1)	62 (27.6)	0.11
	Animal models, n (%)	21 (6.8)	1 (1.2)	20 (8.9)	0.21
	Virtual simulators, n (%)	97 (31.5)	21 (25.3)	76 (33.8)	0.22
	3D printed or other simulators, n (%)	23 (7.5)	2 (2.4)	21 (9.3)	0.4
If you answered "directly on patients" in the question N43, does the patient know that the resident/trainee is operating on him/her?	Yes (N = 77), n (%)	37 (48.1)	8 (53.3)	29 (46.8)	0.6
If you answered "directly on patients" in the question N43, was the operation initially performed under the supervision of a senior resident or a consultant?	Yes (N = 77), n (%)	76 (98.7)	15 (100)	61 (98.4)	0.6
If you answered "directly on patients" in the question N43, is there a theoretical preparation for the specific task before the practical performance?	Yes (N = 77), n (%)	50 (64.9)	12 (80)	38 (61.3)	0.21
If you answered "directly on patients" in the question N43, is there an objective evaluation of this theoretical preparation?	Yes (N = 77), n (%)	18 (23.4)	4 (26.7)	14 (22.6)	0.7
How was your training carried out? You can choose multiple answers.	Execution of surgical tasks step by step, n (%)	102 (33.1)	21 (25.3)	81 (36)	0.11
	Standardized exercises, n (%)	77 (25)	13 (15.7)	64 (28.4)	0.02
	Simulation of the intervention, n (%)	51 (16.6)	8 (9.6)	43 (19.1)	0.05
	Well-defined standardized training program with preclinical and clinical modular training, n (%)	30 (9.7)	3 (3.6)	27 (12)	0.03
How was your training evaluated?	It was not evaluated, n (%)	264 (85.7)	73 (88)	191 (84.9)	0.7
	It was evaluated with a Likert scale (ie, from 1 to 10), n (%)	11 (3.6)	3 (3.6)	8 (3.6)	
	It was evaluated with standardized metrics with specifically defined objectives, n (%)	33 (10.7)	7 (8.4)	26 (11.6)	
At the end of your training, how was the final assessment carried out?	There was no final assessment, n (%)	255 (82.8)	72 (86.7)	183 (81.3)	0.51
	Self-assessment by the trainees, n (%)	28 (9.1)	5 (6)	23 (10.2)	
	Performed by the training company, n (%)	25 (8.1)	6 (7.2)	19 (8.4)	

3D = three dimensional; EU = European; NA = not applicable.

reflect the perspectives of professionals who have concluded their training journey. Education and training in academic centers should hold a prominent position, and 69% of the respondents come from these centers. Furthermore, 73% underwent their training in Europe. Therefore, the survey mostly represents the situation in academic centers in this continent.

As per the survey outcomes, all respondents (100%) gained exposure to open surgery during their training, with over 90% receiving exposure to laparoscopic and endoscopic surgery. However, it is noteworthy that only 46.1% had the opportunity to access robotic surgery. This statistic raises important considerations, indicating a potential deficiency in exposure to the robotic technique. This is particularly significant as robotic surgery is recognized as the standard and widely employed method for addressing localized prostate cancer and various other urological oncological conditions [13,14].

Moreover, in recent years, training has been refining and moving in two main directions:

1. Development and adoption of methodologies that enable trainees to achieve proficiency. Particularly noteworthy results can be found in the literature regarding the use of proficiency-based progression (PBP) methodology in various disciplines, including minimally invasive urological surgery. PBP has demonstrated, in several prospective, randomized trials, the ability to reduce the error rate by approximately 60% when compared with standard training methodologies [15]. The results obtainable with this methodology have made it the methodology chosen for the implementation of training by some medical device manufacturers and scientific societies (ie, EAU Robotic Urology Section—ERUS).
2. Development and implementation, thanks to technological advancements, of training models available in dry, wet, and cadaver labs. Significant progress has been made in the creation of 3D models for surgical education and the implementation of virtual reality simulators. These advancements have revolutionized surgical training by providing realistic and immersive environments for trainees to practice surgical procedures. The use of 3D models allows for a more detailed and accurate representation of anatomical structures, enhancing the understanding of complex surgical procedures. Trainees can manipulate and explore these models, gaining a better spatial understanding and improving their surgical

Table 5 – Responses to endoscopic surgery questions

Endoscopic surgery		Overall (*N* = 308)	Non-EU doctors (*N* = 83)	EU doctors (*N* = 225)	*p* value
How many hours per week are dedicated to training in endoscopic surgery (TURB/P or laser)?	<1 h, *n* (%)	53 (17.2)	3 (3.6)	50 (22.2)	<0.01
	1–5 h, *n* (%)	89 (28.9)	17 (20.5)	72 (32)	
	5–10 h, *n* (%)	61 (19.8)	25 (30.1)	36 (16)	
	>10 h, *n* (%)	54 (17.5)	27 (32.5)	27 (12)	
	NA, *n* (%)	51 (16.6)	11 (13.3)	40 (17.8)	
What types of training in endoscopic surgery did you have? (N54) If you have none, please move on to the next topic	Directly on patients, *n* (%)	242 (78.6)	71 (85.5)	171 (76)	0.07
	Animal models, *n* (%)	9 (2.9)	4 (4.8)	5 (2.2)	0.21
	Virtual simulators, *n* (%)	29 (9.4)	8 (9.6)	21 (9.3)	0.9
	3D printed or other simulators, *n* (%)	25 (8.1)	5 (6)	20 (8.9)	0.4
If you answered "directly on patients" in the question N54, does the patient know that the resident/trainee that the resident/trainee is operating on him/her?	Yes (*N* = 242), *n* (%)	152 (62.8)	55 (77.5)	97 (56.7)	<0.01
If you answered "directly on patients" in the question N54, was the operation initially performed under the supervision of a senior resident or a consultant?	Yes (*N* = 242), *n* (%)	236 (97.5)	68 (95.8)	168 (98.2)	0.3
If you answered "directly on patients" in the question N54, is there a theoretical preparation for the specific task before the practical performance?	Yes (*N* = 242), *n* (%)	152 (62.8)	50 (70.4)	102 (59.6)	0.11
If you answered "directly on patients" in the question N54, is there an objective evaluation of this theoretical preparation?	Yes (*N* = 242), *n* (%)	72 (29.8)	33 (46.5)	39 (22.8)	<0.01
How was your training carried out? You can choose multiple answers.	Execution of surgical tasks step by step, *n* (%)	216 (70.1)	61 (73.5)	155 (68.9)	0.4
	Standardized exercises, *n* (%)	63 (20.5)	19 (22.9)	44 (19.6)	0.5
	Simulation of the intervention, *n* (%)	41 (13.3)	10 (12)	31 (13.8)	0.7
	Well-defined standardized training program with preclinical and clinical modular training, *n* (%)	18 (5.8)	7 (8.4)	11 (4.9)	0.3
How was your training evaluated?	It was not evaluated, *n* (%)	252 (81.8)	54 (65.1)	198 (88)	<0.01
	It was evaluated with a Likert scale (ie, from 1 to 10), *n* (%)	32 (10.4)	18 (21.7)	14 (6.2)	
	It was evaluated with standardized metrics with specifically defined objectives, *n* (%)	24 (7.8)	11 (13.3)	13 (5.8)	
At the end of your training, how was the final assessment carried out?	There was no final assessment, *n* (%)	203 (65.9)	44 (53)	159 (70.7)	<0.01
	Self-assessment by the trainees, *n* (%)	78 (25.3)	24 (28.9)	54 (24)	
	Performed by the training company, *n* (%)	27 (8.8)	15 (18.1)	12 (5.3)	

3D = three dimensional; EU = European; NA = not applicable; TURB/P = transurethral resection of the bladder/prostate.

skills. Additionally, 3D printing technology has made it possible to create patient-specific models, allowing surgeons to practice and plan surgeries in a personalized and precise manner [16–18]. Virtual reality simulators provide a simulated environment that replicates the look and feel of an actual surgical procedure. Trainees can interact with virtual patients, perform surgical tasks, and receive real-time feedback on their performance. These simulators offer a safe and controlled environment for trainees to practice their skills, without the risk associated with real patients [19]. Overall, the development and implementation of 3D models and virtual reality simulators have enhanced surgical education significantly, providing trainees with valuable tools to improve their skills and confidence before performing surgeries on real patients.

Some other models have been developed in accordance with specific methodologies, demonstrating their effectiveness in enabling trainees to achieve proficiency in basic and advanced skills. For example, Puliatti et al. [20–22] have published the validation of a series of exercises developed based on the PBP methodology, involving the use of the chicken model. The authors chose the chicken model because it is inexpensive, biological, and available worldwide.

Despite these advances and the abundant availability of models, courses, and training tools, rather bleak data emerge from our survey. Indeed, 155 (50.3%) of the responders have the possibility to use a dry lab. Only 16.2% of the participants had access to a wet lab: in particular, ten (3.2%), 33 (10.7%), and seven (2.3%) had access to a cadaver lab, an animal lab, and both, respectively. Virtual labs were available in 31.5%, especially for robotics (20.1%) and laparoscopy (17.2%). Only 32.5% of responders benefitted from EAU/ESU activities and 41.6% participated in any official examination such as EBLUS, EST, or others. These results seem to be insufficient, considering that most of the responders come from academic centers in Europe. Surely the enthusiasm for training is not lacking in young surgeons given that despite the scarce availability of labs and the scarce participation in validated training courses organized by scientific societies, they expressed overall satisfaction of surgical training, which in 49.7% was revealed to be satisfactory or very satisfactory.

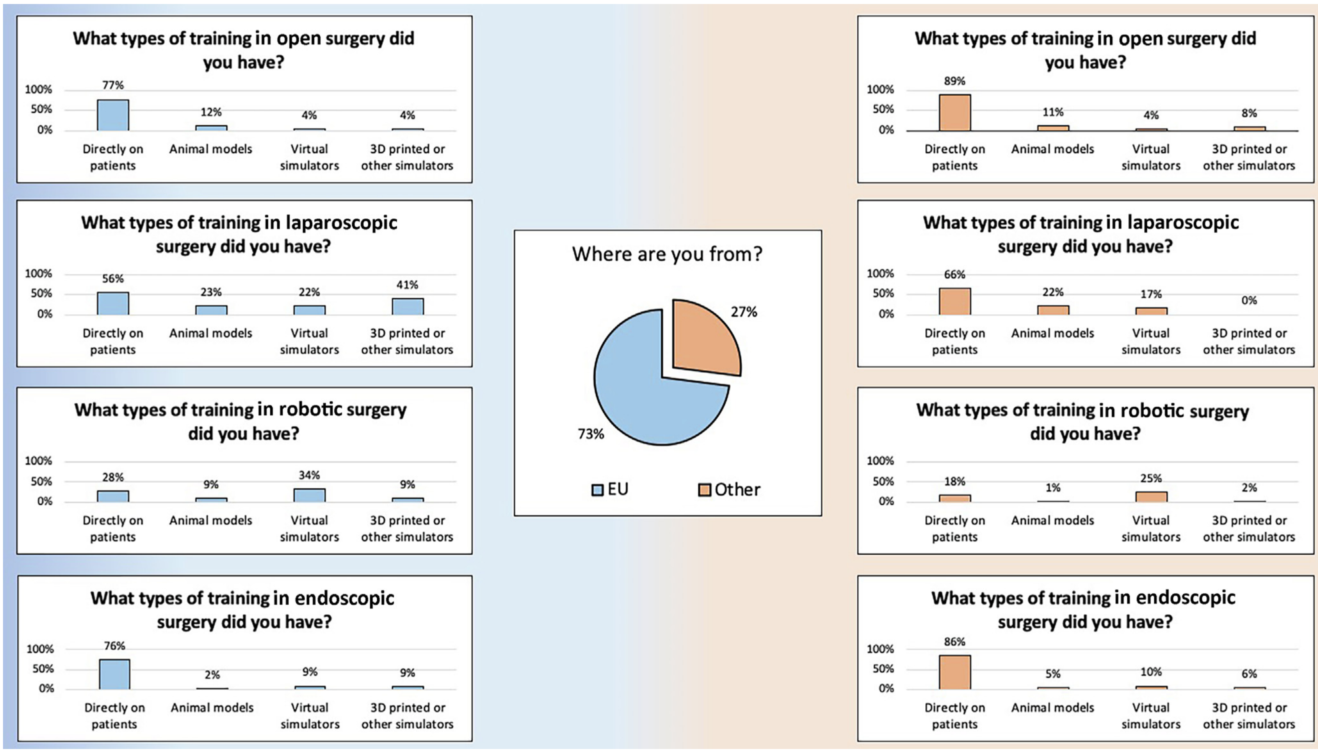

Fig. 2 – Comparison between EU and non-EU doctors' responses stratified according to different types of surgeries. 3D = three dimensional; EU = European.

Our specific findings concerning training in open, laparoscopic, robotic, and endourological surgery call for serious reflection. Notably, 80.5% of respondents in open surgery, 58.5% in laparoscopy, 25% in robotic surgery, and 78.6% in endourological surgery initiated their training directly on patients. This raises an important question: would anyone wish to undergo a procedure performed by trainees who have not received prior specific skills training? Could it be beneficial for academic institutions and professional organizations to enforce licenses obtained only after completing validated training programs that adhere to appropriate methodologies, such as PBP, EST, or EBLUS?

Birkmeyer et al. [23] and Palagonia et al. [24] have already highlighted extensively how novice surgical residents still perform their first surgical steps on patients, risking higher perioperative morbidity. Once again, the solution seems to increasingly lie in the implementation of methodologies such as PBP, which approaches the airline pilot training model by incorporating surgical simulation and validation, and binary performance metrics, as well as using standardized procedure templates as training cornerstones. This would reduce errors and risks for patients during the initial phase of the learning curve [25,26]. From the data emerging from the literature, quality assured theoretical preparation seems to be insufficient for acquiring practical surgical skills [27].

Validated training programs would also allow for an objective assessment of trainees' performance to understand their adequacy in performing the surgical task, also in the light of the different perceptions between the tutor and the trainee [28]. As our study's data indicate, such an assessment appears to be lacking in the vast majority of cases.

The points raised so far seem to be valid even outside Europe. The responders who have undergone a training course outside the EU border have confirmed that even in their experience, often training was carried out directly on the patients, especially in open surgery and endourology. However, non-EU doctors were reported to have received a theoretical preparation and objective evaluation more often than their EU counterparts in both open and endourological surgical training.

Despite the abovementioned interesting findings, our study is not devoid of limitations. First, the chosen diffusion strategy, intended to maximize the number of respondents, precluded the calculation of a precise response rate. Moreover, we observed a significant gender disparity, with 75% of respondents being male. Lastly, the fact that 69.6% of respondents worked in academic centers may limit the representation of peripheral hospitals in our survey.

Nevertheless, the current survey has achieved a broad reach, and the responses reflect the current state of surgical training accurately. Our findings underscore the necessity for well-structured and standardized training curricula in surgical education, which can be facilitated through the integration of new technological tools.

5. Conclusions

The present distribution of surgical training centers fails to guarantee widespread access to standardized training programs. While dry lab facilities are relatively prevalent, the availability of wet lab resources remains limited. Furthermore, it seems that many trainees are initially exposed to surgery through direct interactions with patients.

The findings underscore the importance of implementing a PBP training methodology to enhance the overall quality of surgical training and improve patient outcomes. Further efforts are required to develop standardized training pathways and evaluation methods for different surgical approaches.

Author contributions: Enrico Checcucci had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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Appendix A. Supplementary data

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