



Simulation-Based Training in Basic Surgical Skills: Experiences From a Repeat Cross-Sectional Study in Saudi Arabia

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Introduction: The conventional surgical apprenticeship has been challenged by patient safety concerns, cost of lengthy operation, and surgical complications. Simulation-based training (SBT) has emerged as a realistic option for surgical skills acquisition outside the operating room (OR). The study aimed to document our experience in implementing SBT to acquire basic surgical skills, offered as an educational course, known as the Basic Surgery Skill Course (BSSC).

Methods: This was a repeated cross-sectional study conducted between January 2017 and December 2019 at King Abdulaziz University Hospital (KAUH) in Saudi Arabia, including all participants who participated during BSSCs. A pretested questionnaire was used to collect data on age, sex, training level, institution, overall experience, course overload, course duration, best feature of the course, and whether participants would recommend the course to their colleagues. Whenever possible, self-reported data were compared with registration records, and any conflict was resolved by discussion.

Results: BSSC was found in a total of 489 participants. More than 58% of the participants were men. Majority of students came from out of KAUH (61%) and were medical interns (63%). Overall experience of the course was very beneficial (57%). The course workload and duration were rated as about right by 82% and 75% of participants, respectively. Majority of participants found that the “hands-on practice” as the best segment of the course (76%).

Conclusion: The study showed a positive perception of this surgical education modality among participants. This study will help guide the future research on advanced simulation-based surgical training in the region.

Key words: Medical education – Surgical training – Basic surgery skills – Surgery

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In the last decade, a paradigm shift was observed in the surgical education away from the traditional surgical apprenticeship. In this training model, the opportunity for deliberate practice is rare and sometimes not possible.¹⁻⁵ Recently, this conventional model has been challenged by patient safety, cost of lengthy operation, and surgical complications.⁶⁻⁸

The advanced technology makes the training out of the operation room (OR) possible in a friendly and forgiving environment.^{1,3,9} Fitts and Posner's theory is a well-accepted principle in motor skill science. Hence, practicing the basic skills should be the rule until automaticity was achieved outside the OR.⁵

Since 2007, the American College of Surgeons (ACS) and the Association of Program Directors in Surgery (APDS) have established a national skills curriculum to integrate the simulation into surgical training.^{10,11} However, the implementation of this curriculum in the surgical training program is very low due to a wide range of challenges.¹⁰ These challenges notably include lack of motivated faculty and protected time for surgical trainees.¹⁰

Locally in Saudi Arabia and since 2015, there has been a movement toward incorporating simulation in the health training.¹² In a meta-analysis Saudi study, incorporating simulation in teaching laparoscopy skills at a junior level has been shown to improve cognitive and psychomotor skills. However, the integration of simulation into surgical training programs is still in its initial steps and face different challenges that include a surgeon's acceptance of SBT, cost, and lack of qualified manpower.¹³

In collaboration between different sectors in KAUH including Clinical Skill and Simulation Center (CSSC) and Center of Excellence in Trauma and Accidents (CETA), multiple courses have been developed and implemented to cover a wide range of basic and advanced surgical skills. Therefore, this study aimed to document our experience in implementing SBT to acquire the basic surgical skills offered as an educational course, namely, the Basic Surgery Skill Course (BSSC), and to assess students' perceptions and their overall experience.

Methods

Setting

The study was conducted at a tertiary center, KAUH, Jeddah, Saudi Arabia, between January 2017 and December 2019. The Strengthening the Reporting of Observational Studies in Epidemiology

(STROBE) guidelines of reporting our study methods and results were followed. The Unit of Biomedical Ethics of King Abdulaziz University and the Academic Affairs at KAUH approved the study protocol. An initial invitation and explanation were conducted during the BSSC, and an evaluation form was distributed to participants after the explanation. Informed written consent was obtained from all participants prior to the participation.

Study design

This was a repeated cross-sectional study that aimed to evaluate the overall experience during BSSCs among participants from different medical schools and institutions in Saudi Arabia.

Study participants

All medical students and practitioners who participated in BSSC at KAUH were included between January 2017 and December 2019.

Description of BSSC

BSSC was developed in KAUH as collaboration between multiple sectors in the university, including CSSC and CETA. It was introduced as an initiative for safe surgical practice and for the improvement of basic surgical skills acquisition. The initiative is not limited to KAUH students and is offered to all medical trainees across Saudi Arabia. BSSC was conducted at CSSC in KAUH using different types of simulators (Table 1). BSSC aims to impart essential basic surgical skills and techniques within a controlled environment. The covered surgical skills included (1) knotting and suturing; (2) asepsis and instrument identification; (3) gowning, gloving, and scrubbing; (4) nasogastric insertion and urethral catheterization (surgical tube); (5) chest tube insertion; (6) abscess drainage; (7) local anesthesia infiltration; (8) wound debridement and dressing; and (9) FAST (focused assessment for sonography for trauma) \pm EFAST (extended FAST; trauma ultrasound).

The course employed an instructor-student ratio of 1:4 for a better training opportunity, with a target audience of junior surgical trainees. However, it was made open for other healthcare providers. The course duration was 8 hours, and the course was offered many times during the year consisting of 16 students per course.

Table 1 Equipment and simulators used in Basic Surgery Skills Course (BSSC)

Stations	Equipment
Gowning, gloving, and scrubbing	Scrub brushes, surgical gowns, surgical gloves, masks, theater hats, and shoe covers.
Knotting and suturing	Skin simulator pads, surgical sutures, needle holder, Adson's forceps, suture scissors, sharps bin, knotting boards.
Wound care	I&D simulated cyst/abscess tissue pad, scalpel handle size 3, 11 blade and 15 blade, non-sterile gloves, swabs, forceps, packing mesh, dressing tray, measurement tapes.
Surgical tube	Male and female catheterization simulators, nasogastric tube simulators, different sizes of Foley catheters, different sizes of nasogastric tube, trauma man, different sizes of chest tubes.
Surgical instruments	Different surgical instruments.
FAST/EFAST	Ultrasound simulator, laptops.

Data sources and measurement

A standardized and pretested questionnaire was used to obtain data from a pre-existing mandatory evaluation record. Using a consecutive sample of the first 30 evaluations, the validity of the questionnaire was determined based on three questions according to age, gender, and educational level. Responses from the questionnaire were compared to the evaluation form records. The overall agreement rate was 80%. To reduce the interrater variability, three jointly trained medical secretaries conducted data extraction, following predefined standardized procedures. Any concerns or questions during the data collection were resolved through discussion.

Study variables

Data on age, sex, training level, institution, overall experience, course overload, course duration, best feature of the course, and whether the participant would recommend the course to others were collected. All questions had one answer, except questions regarding the best feature/s of the course, where participants were allowed to select multiple answers.

Statistical methods

A descriptive analysis of study findings was performed, and variables are presented as counts and percentages. Statistical analysis was conducted using the SPSS (IBM, Armonk, NY) and Excel (Microsoft, Redmond, WA) software.

Risk of bias

To reduce the selection bias, all participants enrolled in BSSCs at CSSC in KAUH were included. The questionnaire cross-validated its findings with the

registration and evaluation records were pretested to minimize the measurement bias.

Results

Demographics

The BSSC program included a total of 489 participants between 2017 and 2019. Men accounted for >58% of participants. Most of participants came from outside KAUH (62%). Majority of participants were within the 20–29-year (92%) age group and were predominantly medical interns (63%) (Table 2).

Questionnaire findings

The overall experience of the course was rated as “very beneficial” by a majority of students (57%). The course workload and duration were rated as “about right” by 82% and 75% of participants, respectively. Majority of participants indicated that the practical teaching was the best segment of the course (62%) and 81% reported that they would recommend this course to their colleagues (Table 3).

Trends

The participation in BSSC program markedly declined between 2018 and 2019 (from 164 to 62 participants), with the 2019 attendance comprising only approximately 13% of 489 participants (Fig. 1). However, female participants comprised almost two-thirds of the attendance in 2019, increasing from 43% and 32% in the last 2 years (Fig. 2).

Discussion

This study showed the ability of our institution to introduce the transition toward SBT in surgical education. BSSC had attracted many interested participants from inside and outside of the institu-

Table 2 Demographic of participants in Basic Surgery Skills Course (BSSC)

Variables	2017	2018	2019	Total	Percentage
Gender					
Male	151	111	22	284	58.08
Female	112	53	40	205	41.92
Total	263	164	62	489	100.00
Institution					
KAUH (King Abdulaziz university Hospital)	106	54	26	186	38.04
NON KAUH	157	110	36	303	61.96
Total	263	164	62	489	100.00
Age					
20-29	243	152	53	448	91.62
30-39	6	3	7	16	3.27
40-49	1	0	1	2	0.41
Unspecified	13	9	1	23	4.70
Total	263	164	62	489	
Training					
Medical Student	69	31	3	103	21.06
Medical Intern	156	106	47	309	63.19
Resident/Registrar: 0-2 years for formal surgical training	22	18	11	51	10.43
Resident/Registrar: 3-4 years for formal surgical training	2	0	0	2	0.41
Unspecified	14	9	1	24	4.91
Total	263	164	62	489	100.00

Table 3 Perception of participants on the Basic Surgery Skills Course (BSSC)

Variable	2017	2018	2019	Total	Percentage
Overall experience of the course					
No benefit	1	0	0	1	0.20
Some benefit	17	8	4	29	5.93
Quite helpful	71	33	20	124	25.36
Very beneficial	137	107	35	279	57.06
Indispensable	22	6	3	31	6.34
No answer	15	10	0	25	5.11
Total	263	164	62	489	100.00
Course workload					
Inappropriately low	3	4	3	10	2.04
About right	215	131	56	402	82.21
Inappropriately high	29	18	3	50	10.22
No answer	16	11	0	27	5.25
Total	263	164	62	489	100.00
Course duration					
Too short	17	7	5	29	5.93
About right	191	130	47	368	75.26
Too long	38	14	8	60	12.27
No answer	0	1	0	1	0.20
Best features of the course					
Case discussions/interactive presentation	29	21	19	69	11.46
Practical hands-on segment	208	119	45	372	61.79
Experienced instructors	88	48	18	154	25.58
Others, specify	5	2	0	7	1.61
Total	330	190	82	602	100.00
Would you recommend this course to others?					
Yes	218	121	56	395	80.78
No	10	12	5	27	5.52
No answer	35	31	1	67	13.70
Total	263	164	62	489	100.00

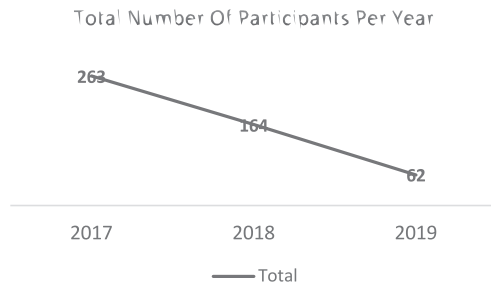


Fig. 1 The total number of participants per year from 2017 to 2019.

tion since its implementation in 2017. The majority of participants realized the importance of SBT in acquiring surgical skills because their overall experience with the program was helpful and very beneficial to their surgical endeavor. This occurs because SBT provides a controlled and forgiving environment that allows trainees to focus and learn psychomotor skills in a much more comfortable way.^{9,14}

However, some challenges were still found in the SBT implementation in our country. The number of participants remarkably declined in 2019, which is in stark contrast to the reality that the majority of participants will recommend this program to their colleagues and found their overall experience helpful and beneficial. However, this decline can be explained by some factors. Changes in the Saudi Commission for Health Specialties (SCFHS) admission criteria in the surgical residency programs across the country in October 2018 were the most common factor that may have influenced this decline.¹⁵ Since then, the SCFHS does not consider preadmission surgical skill courses and focuses only on theoretical grades of the applicants. These selection criteria changes are in contrast to the overwhelming evidence that support SBT in surgical training.^{9,16–18} However, the reasons and impact of this decision are outside the scope of this study. Subsequently and to compensate for the low number of applicants, the price of BSSC was increased. Undoubtedly, this increased price is another logical reason that limits the number of applicants since October 2018. In addition, the study consistently showed a low participation from the surgical residency programs. Grabski *et al* also showed a very low implementation of the ACS/APDS curriculum due to low motivation of faculties in surgical programs and lack of protected time for residents in their survey study.^{10,11}

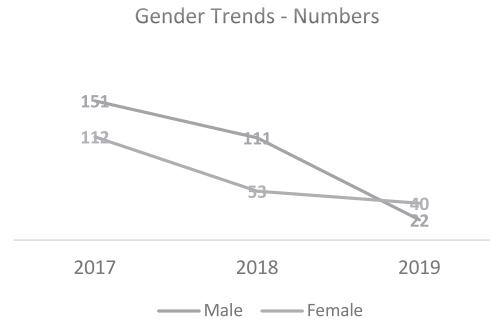


Fig. 2 Participation by gender from 2017 to 2019.

The number of male participants was found to be higher than that of female participants who are attracted to BSSC. This could be due to the gender tendency toward surgical specialty.^{19,20} Hui-Ling Kerr *et al* have shown in their survey study that life-work balance is still a real barrier toward the surgical career for most women.²⁰ However, our study showed a trend of a significant increase in female participation in 2019 compared to male participation. This could be a reflection of the recent national political changes that support women rights and allow equal treatment of both sexes in the country.

Intern students were the most attracted groups that joined BSSC. Medical interns, who are fresh graduates from medical schools and not enrolled in any surgical residency programs, were the more eager group to be part of these educational activities. This has also been noted in previous studies and can be explained by a possible deficit in undergraduate surgical skills education and/or to challenges they face in complex clinical settings during their clinical rotations.^{21–23}

The majority of participants featured the “hands-on practice” segment of this program. This corresponds with the overwhelming evidence that SBT is very effective and more powerful toward skill acquisition compared to the traditional medical learning method.^{17,24} In 2019, a study showed a small increase in the percentage trend of the “interactive discussion” segment of the program. This could be explained by the quality of the participation in 2019. Since changes in the admission criteria by SCFHS, participants, who enrolled in the BSSC program, were more self-driven and conscious about their surgical training needs. This added more to the quality of “interactive discussion” of the program.

The study presents some strength points. It is one of the early studies that promote SBT in the region with a relatively large number of samples. More-

over, the sample represented a wide range of medical schools with different academic years and clinical levels. However, our study shares other limitations of the questionnaire study regarding the quality of obtained answers and data collected. Some participants left questions unanswered. However, their percentage was very minimal and had no significant effect on the main points of the study. Again, this is an observational study, and confounding selection bias is impossible. However, to mitigate this risk, all participants during the study period were included.

Conclusion

The simulation-based surgical education is a valid option for advanced surgical training in the region. The study showed the positive perception of this surgical education modality among participants. However, several challenges were still observed to maintain this type of training. Therefore, this study will help guide future researches on advanced simulation-based surgical education in the region.

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