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The surgical clinical training measurement: developing and evaluating the quality of surgical clinical training among Syrian surgical residents

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Abstract

Background Evaluation tools for training programs vary, necessitating a standardized tool for assessing surgical clinical training quality to enhance program effectiveness, pinpoint improvement areas, and ensure resident readiness for independent practice. We present a new tool designed to provide a reliable and consistent framework for evaluating the effectiveness of surgical clinical training.

Methods The Surgical Clinical Training Measurement (SCTM) was developed using the modified Delphi method to evaluate ten variables, including core competencies specific to surgical training. It employs a 5-point Likert scale, with scores ranging from 40 to 200. General surgery residents completed the SCTM twice to evaluate training levels. Results were categorized based on score ranges. Statistical analysis via SPSS included descriptive statistics, group comparisons, internal consistency assessments, correlations, and reliability tests to evaluate the SCTM scores, demographic characteristics, and language versions. ANOVA, Chi-Square, Cohen Kappa, and Spearman's rho tests were employed for data analysis.

Results 74 general surgery residents at Aleppo University Hospital have participated in this study. The SCTM scores indicated a mean total score of 131.42, with most residents falling into the good satisfactory category. Analysis showed no significant differences in total scores across specialty years, but post-hoc tests revealed differences between specific years. The SCTM demonstrated strong reliability, with a Kappa value of 0.884 indicating high agreement between English and Arabic versions ($p < 0.05$). Test-retest reliability was also high ($r = 0.964$, $p < 0.01$). Internal consistency was excellent across various domains, reinforcing its validity in surgical education. The analysis of variables showed different levels of reliability and mean scores among the various factors. The Pre-Operative Clinical variable had the highest performance, while the Evidence-Based Quality Clinical Training variable indicated the most potential for improvement. The strong positive correlations between various domains of SCTM emphasize the interconnected nature of skill development, with proficiency in patient care closely linked to competency in other areas such as Medical Knowledge, Practice-based Learning and Improvement, and Evidence-Based Quality Clinical Training.

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Conclusion SCTM offers a standardized and cohesive method for evaluating the quality of surgical clinical training. It's a valuable resource for program directors, educators, and residents to assess and enhance training programs, and identify specific areas for improvement. Additional research is required to validate the SCTM in different settings and explore its applicability in other fields.

Clinical trial number Not applicable.

Keywords Surgical clinical training, Surgical theater, Quality of training, Surgery, Residency, Measurement

Introduction

Surgical residency training is a cornerstone in preparing future surgeons to provide safe and effective patient care. The quality of this training significantly impacts the development of essential skills, knowledge, and attitudes required for independent practice.

Evaluation of the quality of clinical training for surgical residents involves assessing various aspects of their training program to ensure it meets desired standards and produces competent surgeons [1–3]. This process aims to measure the training program's effectiveness and identify improvement areas.

While various assessment tools and methods exist for evaluating surgical training, they often focus on specific aspects of training, such as technical skills or knowledge acquisition, and may lack a comprehensive and integrated approach to assessing the overall quality of training [4, 5].

Furthermore, the subjective nature of evaluations and the variability in training resources and methodologies across institutions complicate the development of universally applicable tools for assessing surgical clinical training quality [6–9].

A scoping review of 68 articles emphasizes the necessity for evidence-based indicators in surgical training, especially in low-resource settings, through quantitative and qualitative studies. It also focuses on benefits to trainees and patients, prioritizing training success, career progression, and patient safety [10]. Similarly, the systematic review of 42 studies points out a shift towards competency-based training in surgery and the need for further investigation on its impact on clinical outcomes. It advocates for the transition from technical proficiency to clinical competency and the development of validated assessments to support continuous surgical education and skill improvement [11].

Ensuring high-quality surgical training is essential for preparing competent and skilled surgeons. This highlights the need for a comprehensive and standardized tool to evaluate the quality of surgical clinical training. This study aims to develop a tool to effectively measure various dimensions of surgical training, including technical skills, decision-making, communication, professionalism, and patient safety, thereby contributing to the overall enhancement of surgical training standards. To guide this research, the following questions will be addressed: What specific dimensions of surgical training can be accurately measured? How can these measurements influence the improvement of training practices? What benchmarks can be established to ensure consistency in surgical training quality?

Methods

Study design and ethical approval

This study was performed under ethical approval from the ethics committee at the Faculty of Medicine, University of Aleppo, and The Syrian Virtual University (SVU) (Number: 4289/0). Informed consent was obtained from all participants before participating.

The Surgical Clinical Training Measurement (SCTM) was designed using a systematic approach following the modified Delphi method [2, 6], a structured communication technique that gathers expert opinions through a series of sessions. This process involved the following steps:

First, a panel of expert surgeons, educators, and researchers in the field of surgery was identified to participate in the Delphi process based on their expertise and experience in surgical education and training. An initial version of the SCTM was then developed through a comprehensive literature review on surgical training, competency assessment, and clinical skill development, involving the identification of relevant studies, articles, and guidelines on surgical training. This literature search ensured that the SCTM was evidence-based. The methodology for designing the scale and a review of the tools and sources used to define the evaluation criteria in surgical training are in Appendix A [1, 4, 5, 7, 10–18].

The Delphi process for the measurement consisted of multiple rounds of data collection and analysis where experts reviewed the SCTM and provided feedback on its content, clarity, comprehensiveness, and relevance. The measurement was revised and refined iteratively based on experts' feedback until a consensus was reached. Pilot testing was then conducted with surgical residents to evaluate the feasibility, reliability, and validity of the final version of the SCTM.

Furthermore, this study was conducted at Aleppo University Hospital following the STROBE guidelines for cross-sectional studies [19].

Variables defining and measurement

The SCTM consisted of 40 items that assessed ten variables. These included the original six general core competencies developed by the Accreditation Council for Graduate Medical Education (ACGME) and American Board of Medical Specialties (ABMS) for practicing physicians: **Patient Care**, **Medical Knowledge**, **Practice-Based Learning and Improvement**, **Interpersonal and Communication Skills**, **Professionalism**, **and Systems-Based Practice.** [20, 21] Additionally, the SCTM integrates four surgery-specific variables: **pre-**, **peri-**, **and post-operative care**, **as well as evidence-based quality clinical training in the Department of Surgery.** Definitions for each variable, and their components are detailed in (Appendix A).

The SCTM included specific criteria aligned with each competency. It was designed as a 40-item tool using a 5-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Uncertain, 4 = Agree, and 5 = Strongly Agree), with overall scores ranging from 40 to 200. Two of the items were negatively worded [22].

Participants

Data collection was conducted through a validated online questionnaire (Google Forms) in both Arabic and English versions between January 31 and February 15, 2024, with a two-week interval for retest reliability. The measurement also gathered demographic details such as age, gender, and residency year.

The overall SCTM scores ranged from 40 to 200 and were divided into four performance levels:

- 40–80: **Low**-quality training.
- 81–120: **Moderate** training.
- 121–160: **Good** training.
- 161–200: **Superior** training.

This classification aligns with the Surgical Theatre Educational Environment Measures (STEEM) framework, which measures the surgical work environment [4, 15].

Additionally, each item and variable were also categorized based on the mean score as follows:

- 1-1.80: **Low**-quality training.
- 1.81–2.60: **Moderate** training.
- 2.61–3.40: **Good** training.
- 3.41–4.20: **Superior** training.
- 4.21-5: **Excellent** training.

The results were interpreted at the item, variable, and overall levels to provide a comprehensive understanding of training quality.

Statistical analysis

The data were analyzed using SPSS software (version 26.0). Descriptive statistics, including mean, standard deviation, frequencies, and percentages, were used to summarize quantitative and categorical variables. Total SCTM scores were analyzed using the following statistical methods: Group Comparison of the total SCTM scores was conducted using the Pearson Chi-Square test to evaluate differences in SCTM scores between male and female residents [23]. One-way ANOVA was employed to assess significant variations in SCTM scores across different residency years. The reliability and consistency of the SCTM were evaluated using multiple statistical tests. The Cohen's Kappa test measured agreement between the Arabic and English versions of the measurement [24]. Test-retest reliability was assessed using Spearman's rho. Test-retest reliability was evaluated using Spearman's rho, while internal consistency for each variable was determined using Cronbach's Alpha, with a threshold of ≥ 0.6 considered acceptable [25]. Correlations between variables were examined using Pearson Correlation to identify potential associations. These methods ensured a robust and comprehensive analysis of the data, providing insights into the reliability and validity of the SCTM.

Results

Participants and descriptive data

The study included 74 general surgery resident participants from Aleppo University Hospital, with a mean age of 27 years (range: 24–31). The sample comprised 63 males (85%) and 11 females (15%). Participants were distributed across the residency years as follows: 28 (37.8%) in their 1st year, 14 (18.9%) in their 2nd year, 13 (17.6%) in their 3rd year, 14 (18.9%) in their 4th year, and 5 (6.8%) in their 5th year. The mean total SCTM score was 131.42 (SD = 22.64), indicating generally positive satisfaction with the quality of surgical clinical training. Most participants (55.4%) scored in the "Good training" category, 24 residents (32.4%) were classified as "Moderate training," 7 residents (9.5%) achieved "Superior training," and 2 residents (2.7%) fell into the "Low-quality training" category. The Surgical Clinical Training Measurement (SCTM) items for each question are summarized in Table 1. Additional details regarding the Arabic version, along with the objective of each item and its corresponding indicator, are presented in (Appendix A).

The lowest-scoring items were Q34 (mean = 1.65) and Q39 (mean = 1.49), reflecting the limited involvement of international university consultants in final interviews and the lack of virtual reality simulators for surgical training. Conversely, high scores were observed for items assessing comprehensive history (Q1: 4.27), thorough physical examination (Q2: 4.62), requesting unnecessary tests (Q3: 4.30), active supervisor participation in

Table 1 Items' results

	Item's ID	Mean	SD	Total percent
	Preoperative Items			
Q1	A detailed clinical history is written for the surgical patient. (Including the chief complaint, a detailed description of the complaint, the patient's medical history, and social habits)	4.27	0.78	85.41
Q2	A thorough physical examination is conducted for the surgical patient. (For example, the examination is performed to assess the presence of surgical signs, such as rebound tenderness).	4.62	0.61	92.43
Q3	Diagnostic investigations, both invasive and noninvasive, are requested with equal priority to establish a final diagnosis. (For example, requesting a CT scan before an ultrasound to diagnose gallstones) *	4.30	0.93	85.32
Q4	The resident should be able to comprehend the treatment plan options proposed for the patient. (That means he understands the advantages and disadvantages of both conservative and surgical management)	3.19	1.11	63.78
Q5	The management plan for the admitted patient is formulated in consultation with the supervisor. (That means the supervisor is the final decision-maker regarding the treatment plan).	4.027	0.99	80.54
Q6	The resident demonstrates respect for patient confidentiality. (For example, the patient's health condition or medical records are not disclosed to individuals other than the healthcare team.)	4.027	1.17	80.54
Q7	The resident effectively explains to the patient the steps of diagnosis and management. (For example, Explanation of the diagnostic and management approach for appendicitis.)	3.62	0.99	72.43
Q8	The resident deals with patients and their families with compassion and care. (For example, the resident kindly requests the patient to sit down if he is standing while having a conversation.)	3.65	1.08	72.97
Q9	The resident strictly adheres to the department's treatment plan policies. (For example, The trauma management protocol).	3.80	1.03	75.95
Q10	The resident strictly adheres to infection control policies. (For example, using hand sanitizers)	2.77	1.24	55.41
	Perioperative Items			
Q11	The supervisor usually participates as a first assistant in basic operations (For example he is involved in cholecystectomy).	2.47	1.04	49.46
Q12	The supervisor is always involved in advanced operations	4.36	0.99	87.30
Q13	(For example, the supervisor is the primary surgeon in colon cancer surgery)	3.08	1.07	61.62
Q14	The supervisor asks questions during the surgical procedure (For example, the supervisor may ask questions related to the steps of the surgical procedure (	2.05	1.26	41.08
Q15	The resident remains wearing the surgical scrub outside the operating room. (For example, the resident may walk around the hospital while wearing the surgical scrub) *	4.45	0.78	88.92
Q16	The supervisor is present physically during emergency surgeries. (That means, the supervisor can be found either in the operating theater or the resting area (room)).	3.76	0.99	75.14
Q17	The residents are responsible for documenting the operation data in real-time. (That means, the operation data is promptly documented immediately after the completion of the surgery.)	4.11	1.04	82.16
	Postoperative items			
Q18	The discharge plan is discussed with the supervisor to provide the best health care. (That means the patient's follow-up plan and medication are reviewed with the supervisor.)	3.81	1.06	76.22
Q19	The patient is discharged electronically. (That means the patient data is electronically documented, and upon discharge, he is provided with a copy of the summary of his current medical file.)	4.43	0.68	88.65
Q20	The residents practice the cost-effective medicine. (For example, in cases where the patient can tolerate oral medications, intravenous medications are omitted.)	3.74	1.10	74.86
Q21	There is a clear "case log" of surgical operations during the training period. (That means the resident must participate in a defined number of surgical procedures to be qualified for the final examination. For example, meeting the qualification criteria for the Arab Board.)	2.53	1.30	50.54
Q22	The latest version of the Enhanced Recovery After Surgery (ERAS) guidelines is implemented in every specialty.	2.35	1.16	47.03
Q23	The residents conduct a morning round with the supervisor to visit the patients.	3.07	1.29	61.35
Q24	The residents conduct an evening round with the supervisor to visit the patients.	2.49	1.23	49.73
Q25	The resident is trained on how to break bad news (BBN) to the patients and their relatives. (For example, conveying news of a patient's death)	2.62	1.16	52.43
Q26	The concern is taken to provide the best healthcare to the patient while also aiming to minimize the hospital stay duration.	3.77	1.01	75.41
	Evidence-based quality clinical training in the department of surgery Items			
Q27	Scientific sessions are held to discuss the latest recommendations according to each specialty.	3.32	1.18	66.49
Q28	Morbidity and mortality meetings are conducted periodically within the surgical department. (For example, cases of complications and deaths are presented for discussion.)	2.46	1.25	49.19
Q29	Documented patient data is used to conduct research. (For example, the hospital's patient database is utilized for master's research studies(.	3.42	1.06	68.38

Table 1 (continued)

	Item's ID	Mean	SD	Total percent
Q30	The resident undergoes at least one training in the field of continuing medical education (CME) within his specialty annually. (For example, a surgical resident attends an Advanced trauma life support (ATLS) course).	2.30	1.17	45.95
Q31	The residents participate in presenting clinical cases in the Department of Surgery. (For example, residents present clinical cases under the guidance of supervisors in monthly meetings.)	4.38	0.86	87.57
Q32	The residents request feedback and evaluation from their supervisor regarding their medical practice.	3	1.29	60.00
Q33	The consultants from other local universities attend the final residency interviews.	1.85	1.25	37.03
Q34	The consultants from other universities outside the country attend the final residency interviews.	1.65	1.21	32.97
Q35	The residents are involved in the training of medical students at the hospital. (For example, the residents are actively involved in presenting the clinical cases to medical students)	3.42	1.29	68.38
Q36	The residents share concise information only when it is evidence-based. (For example, attributing the mentioned information to a reference, or scientific research)	3.04	1.18	60.81
Q37	The Department of Surgery organizes social activities to enhance interpersonal skills among the residents. (For example, arranging groups to attend a surgical conference.)	2.46	1.38	49.19
Q38	There is a well-defined system for evaluating performance, granting rewards, and imposing penalties	1.99	1.38	38.38
Q39	There are virtual reality simulators available for training on surgical procedures. (For example, three-dimensional glasses.)	1.49	1.14	29.73
Q40	The residents demonstrate an understanding of basic sciences. (For example, anatomy and physiology)	2.97	1.01	59.46
	Total SCTM score	131.42	22.64	65.71

*: Inverted questions should be reversed coding

advanced operations (Q12: 4.36), supervisor oversight during elective surgeries (Q15: 4.45), electronic patient discharge (Q19: 4.43), and resident participation in clinical case presentations (Q31: 4.38). (Appendix A).

The analysis of variance (ANOVA) revealed no statistically significant differences in total SCTM scores across the specialty years ($F = 2.002$, $P = 0.104$). However, post hoc analyses (Tukey's HSD, LSD, and Dunnett T3) identified two significant differences: between 1st and 3rd-year residents (mean difference = -16.047, $P = 0.034$) and between 3rd and 5th-year residents (mean difference = 26.754, $P = 0.017$). Pearson's Chi-Square test showed no significant association between SCTM scores and gender ($\chi^2 = 2.249$, df = 3, $P = 0.522$).

Reliability of the measurement

The SCTM demonstrated strong reliability across various measures. The Kappa value of 0.884 indicated a high level of agreement between the English and Arabic versions of the SCTM ($p < 0.05$). Test-retest reliability, measured by Pearson's correlation coefficient, was also high ($r = 0.964$, $p < 0.01$, 2-tailed), confirming the SCTM's consistency over time.

Internal consistency analysis using Cronbach's Alpha showed excellent reliability for Medical Knowledge ($\alpha = 0.843$), Practice-Based Learning and Improvement ($\alpha = 0.829$), Interpersonal and Communication Skills ($\alpha = 0.803$), Systems-Based Practice ($\alpha = 0.846$), Post-Operative Clinical variable ($\alpha = 0.815$), and Evidence-Based Clinical Training ($\alpha = 0.893$). Patient Care ($\alpha = 0.677$), Professionalism ($\alpha = 0.677$), and Pre-Operative Clinical variable ($\alpha = 0.784$) demonstrated good reliability, while the Peri-Operative Clinical variable ($\alpha = 0.517$) showed acceptable reliability.

Variables' analysis

The study assessed multiple domains of surgical clinical training, revealing a range of performance levels. The Pre-Operative Clinical domain achieved the highest score (mean = 3.82, SD = 0.59, total percentage = 76.49%), reflecting strong preparation during this phase. Conversely, Evidence-Based Quality Clinical Training recorded the lowest score (mean = 2.69, SD = 0.77, total percentage = 53.80%), indicating a critical area for improvement.

Other domains, such as Patient Care, Medical Knowledge, Interpersonal and Communication Skills, and Practice-Based Learning and Improvement, demonstrated moderate performance, with mean scores ranging from 2.83 to 3.34. The Peri-Operative Clinical domain showed relatively higher performance (mean = 3.47, SD = 0.52, total percentage = 69.31%), highlighting a robust focus on this phase of training (Table 2).

Pearson correlation analysis (significance level = 0.01) revealed strong positive relationships between the evaluated domains, emphasizing the interconnected nature of clinical skills. For instance, Patient Care exhibited significant correlations with Medical Knowledge ($r = 0.902$), Practice-Based Learning and Improvement ($r = 0.961$), and Evidence-Based Quality Clinical Training ($r = 0.907$). Similarly, Medical Knowledge strongly correlated with Evidence-Based Quality Clinical Training ($r = 0.940$), underscoring the role of evidence-based practices in enhancing knowledge acquisition.

Table 2 Variables analysis

Variables	Mean	SD	Total percent	No. items	Items ID
Patient Care	3.07	0.59	61.31	6	Q1, Q2, Q4, Q5, Q11, Q14
Medical Knowledge	2.83	0.73	56.34	9	Q4, Q13, Q27, Q29, Q31, Q33, Q34, Q39, Q40
Interpersonal and Communication Skills	3.08	0.82	61.62	6	Q7, Q8, Q23, Q24, Q25, Q36
Systems-based Practice	3.30	0.57	66.02	19	Q3, Q5, Q9, Q10, Q14, Q15, Q16, Q17, Q18, Q19, Q20, Q21, Q22, Q26, Q27, Q28, Q30, Q37, Q38
Practice-based Learning and Improvement	3.07	0.57	61.49	17	Q11, Q12, Q13, Q15, Q16, Q19, Q21, Q23, Q25, Q29, Q30, Q31, Q32, Q33,Q34, Q35, Q39
Professionalism	3.34	0.61	66.76	9	Q6, Q7, Q8, Q12, Q20, Q24, Q26, Q37, Q38
Pre-Operative Clinical variable	3.82	0.59	76.49	10	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10
Peri-Operative Clinical variable	3.47	0.52	69.31	7	Q11, Q12, Q13, Q14, Q15, Q16, Q17
Post-Operative Clinical variable	3.20	0.71	63.99	9	Q18, Q19, Q20, Q21, Q22, Q23, Q24, Q25, Q26
Evidence-based quality clinical training	2.69	0.77	53.80	14	Q27, Q28, Q29, Q30, Q31, Q32, Q33, Q34, Q35, Q36, Q37, Q38, Q39, Q40

Overall, the correlations highlight those improvements in one domain, such as Evidence-Based Training, will positively impact other aspects of clinical performance, reinforcing the need for a holistic approach to surgical education. (Appendix B).

Discussion

Main results and comparison with prior work

Studies in the medical field frequently emphasize variables such as clinical skills, knowledge acquisition, professionalism, communication skills, and patient care as critical components of quality clinical training. Evaluation methods described in these studies often rely on feedback from trainees, program supervisors, or a combination of both, underscoring the value of multiple perspectives in assessing the effectiveness and impact of clinical training programs [10, 18, 26, 27]. We propose that the SCTM serves as a unifying framework that evaluates individual competencies and emphasizes their interconnectedness. By employing a comprehensive and standardized approach, SCTM overcomes the limitations of traditional tools that frequently focus on isolated aspects of a trainee's development.

The findings of this study highlight the SCTM as an impactful tool in evaluating the quality of surgical education, providing a comprehensive and standardized approach that addresses limitations in existing evaluation methods. Unlike other conventional evaluation methods in surgical education, such as STEEM [4], JCST Trainee Survey [12], and universal global rating [5], tend to focus on singular aspects of a trainee's development. These tools often measure specific competencies in isolation, such as clinical skills or knowledge acquisition, neglecting the interconnected nature of surgical training. This narrow focus can lead to incomplete evaluations, hindering the ability to appreciate how multiple competencies work together in real-world surgical practice.

Moreover, the existing tools often lack standardization and fail to provide a comprehensive framework for assessors. This inconsistency can result in subjective interpretations of trainee performance and inadequate feedback, making it difficult for programs to identify strengths and areas for improvement effectively.

The study revealed an overall good satisfaction level (mean SCTM score = 131.42), indicating the general effectiveness of the training program. However, significant gaps were identified in domains such as Evidence-Based Quality Clinical Training (mean = 2.69) and Medical Knowledge (mean = 2.83). These results underscore the pressing need to incorporate evidence-based practices into surgical education, which is critical for equipping residents with decision-making capabilities grounded in research and best practices. For instance, the low scores in Evidence-Based Quality Clinical Training stem from insufficient curriculum emphasis on Evidence-Based practices, limited research exposure, lack of mentorship, and inadequate assessment methods. To improve, programs should revise curricula, offer workshops, create research opportunities, utilize advanced assessments, encourage quality improvement projects, and foster an Evidence-Based practices culture.

On the other hand, strong performance was observed in the Pre-Operative Clinical domain (mean = 3.82, 76.49%), reflecting active preparation during this phase. Similarly, the Peri-Operative Clinical domain (mean = 3.47, 69.31%) demonstrated relatively high scores, emphasizing effective surgical theater training. These findings suggest that while foundational skills and operative preparation are adequately addressed, advanced competencies such as integrating evidence-based approaches remain areas for targeted improvement.

The SCTM's rigorous design is based on established educational frameworks, including the Accreditation Council for Graduate Medical Education (ACGME) core competencies. It incorporates ten key variables, including examples such as Patient Care and Interpersonal and Communication Skills, as well as surgical-specific domains like Pre-, Peri-, and Post-Operative care. The

SCTM ensures a balanced evaluation of technical, cognitive, and professional aspects of surgical training. This multidimensionality is pivotal for capturing the complex nature of surgical education, which demands simultaneous proficiency in diverse competencies.

Moreover, the SCTM demonstrated strong psychometric properties, with reliability measures (Cronbach's Alpha values ranging from 0.517 to 0.893) supporting its consistency and accuracy. High test-retest reliability ($r = 0.964$, $p < 0.01$) and strong agreement between the English and Arabic versions (Kappa = 0.884) affirm its adaptability across different linguistic and cultural contexts, making it a versatile tool for global implementation.

The correlations observed between domains, such as Patient Care and Evidence-Based Training ($r = 0.907$), highlight the interconnected nature of surgical competencies. These relationships suggest that enhancing evidence-based practices could positively influence other critical domains, such as medical knowledge and patient outcomes. The SCTM's ability to identify these interrelationships enables educators to develop targeted interventions that enhance the effectiveness of training across all domains. Furthermore, the identification of significant differences between training years (e.g., 1st and 3rd years, $P = 0.034$) underscores the importance of tailoring educational strategies to the evolving needs of residents. Programs must prioritize stage-specific enhancements, such as early integration of technology-based learning tools (e.g., virtual reality simulators) and fostering international collaborations to bridge identified gaps in resources and mentorship. Importantly, the Pearson's Chi-Square test results indicate no significant association between SCTM scores and gender, suggesting that self-assessments of competency are relatively uniform across genders within this sample.

The findings of this study also underscore the SCTM's role as a transformative tool in global surgical education, offering a comprehensive evaluation that bridges existing gaps in assessment methods. By integrating essential competencies and surgical-specific variables, the SCTM provides a holistic view of clinical training quality, essential for enhancing surgical programs worldwide.

Limitations

The measurement was applied exclusively to general surgery residents in a single institutional setting, which limits its generalizability to other specialties or training programs. Furthermore, the study relied solely on trainee self-assessments, excluding input from program supervisors, which could provide a more balanced and comprehensive evaluation. Self-assessments may be subject to biases such as overconfidence, social desirability, or lack of self-awareness, which can distort the accuracy of the results. The measurement did not assess the surgical technical skills, such as the ability to handle instruments and the efficiency in performing procedures. Additionally, it did not differentiate between surgical environments in terms of experience and resources for laparoscopic and open surgery.

To address these limitations, future research should focus on validating the SCTM across diverse specialties and clinical settings, integrating supervisor perspectives, and ensuring its comprehensiveness in assessing surgical skills across different surgical environments, including both laparoscopic and open surgery.

Conclusions

The SCTM provides a standardized and cohesive method for evaluating the quality of surgical clinical training. It is a valuable resource for program directors, educators, and residents to assess and enhance training programs, and identify specific areas for improvement. It helps provide accessible, high-quality training for residents, thoroughly preparing them for independent surgical practice. Additional research is necessary to validateits use in diverse settings, explore its applicability to other medical fields, and assess its impact on surgical performance and patient outcomes.

Abbreviations

SCTM	Surgical Clinical Training Measurement
ACGME	Accreditation Council for Graduate Medical Education
ABMS	American Board of Medical Specialties
STEEM	The Surgical Theater Educational Environment Measures
JCST	The Joint Committee on Surgical Training

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12909-025-07043-8.

Supplementary Material 1: Appendix A: Measurement design details.

Supplementary Material 2: Appendix B: Output of the study.

Supplementary Material 3: Appendix C: Full data.

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Author contributions

Ahmad Ghazal; Study Coordinator, Study Design, methodology, validation, data analysis, data interpretation, writing– original draft and reviewing. Mayssoon Dashash; Scientific supervision, and validation.

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Data availability

The data used for this article is shown in Appendix C.

Declarations

Ethics approval and consent to participate

This study was performed under ethical approval from the ethics committee at the Faculty of Medicine, University of Aleppo, and The Syrian Virtual University (SVU) (Number: 4289/0). Informed consent was obtained from all participants before participating. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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