

# PRACTICAL TRAINING IN THE RESIDENCY PROGRAM IN ANESTHESIOLOGY AND INTENSIVE CARE USING SIMULATION-BASED EDUCATIONAL TECHNOLOGIES — RESULTS OF AN ANONYMOUS SURVEY OF RESIDENTS AND 2025 RESIDENCY GRADUATES

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DOI: 10.46594/2687-0037\_2026\_1\_2155

**Abstract.** To study the subjective assessment and satisfaction with the organization of practical training during education using simulation-based educational technologies, an anonymous online survey (22 questions) was conducted among students and graduates of the 2022–2025 clinical residency program. A total of 291 responses were received. The results of the study revealed a lack of a systematic approach to teaching practical skills and limited training on procedures for handling critical situations. A significant portion of respondents indicated incomplete mastery of procedures during training, a lack of theoretical and practical training in the residency program, and, consequently, doubts about their readiness to act in critical situations. Thus, according to the survey data, practical training during residency in anesthesiology and critical care does not fully ensure confident mastery of practical skills for performing procedures or prepare graduates, using simulation technologies, for independent work in various critical situations.

**Keywords:** simulation training in anesthesiology and critical care medicine, practical training in residency, online survey, critical situations.

**Conflict of interest.** The author declares no conflict of interest.

The author declares that he is a member of the editorial board of the journal “Virtual Technologies in Medicine.” The manuscript underwent the standard independent peer-review procedure, and the decision to publish was made independently of the author.

**For citation:** Andreenko A. A. Practical training in the residency program in “Anesthesiology and Resuscitation” using simulation-based educational technologies — results of an anonymous survey of residents and 2025 residency graduates // Virtual Technologies in Medicine. 2026. No. 1. Pp. 8–13. DOI: 10.46594/2687-0037\_2026\_1\_2155

**Scientific specialty:** 3.1.12. Anesthesiology and Resuscitation; 3.2.3. Public Health and Health Care Organization, Sociology and History of Medicine

*Received by the editorial office on January 4, 2026.*

*Received after peer review on February 13, 2026*

*Accepted for publication on February 13, 2026*

## Relevance

The readiness of residents in the specialty of “anesthesiology and intensive care” for future clinical practice is determined by the level of theoretical knowledge acquired, the confident mastery of practical skills, and the acquisition of so-called non-technical skills. The level of practical training of residency program graduates can be assessed through the initial specialized accreditation process, 360-degree workplace evaluations, and employer performance reviews over a specific time period. Feedback from students and residency program graduates is also one of the methods for obtaining information about the training process and outcomes. Surveys of residents currently being conducted at universities across the country focus on assessing student satisfaction with general aspects of the educational process and do not evaluate in detail the quality of practical training or the role of simulation tech-

nologies during training [2; 3]. At the same time, numerous studies have demonstrated that the effective use of simulation-based educational technologies, given the limited opportunities to acquire skills while working with real patients, is a crucial factor in shaping young professionals who are ready for real-world practice.

## Research Objective

To analyze the subjective assessment and satisfaction of students and graduates of the 2022–2025 clinical residency program regarding the organization of practical training during their studies using simulation-based educational technologies in the educational process at universities in our country.

## Materials and Methods

A research group comprising experts from the Federation of Anesthesiologists and Resuscitators (FAR), the Association of Anesthesiologists and Resuscitators (AAR), and Rosomed developed a 22-question survey. The questions were directed at medical school graduates currently undergoing residency training in anesthesiology and intensive care, as well as graduates of the 2022–2025 residency programs. The organization of practical training, teaching methods, and the list of practical skills mastered using simulation equipment were also analyzed. The organization of the system for assessing the mastery of practical skills, its methodology, and forms were examined. Particular attention was paid to training residents in actions during critical situations in anesthesia and intensive care using highly realistic simulation equipment. Mastering these “non-technical skills” is extremely important for the future clinical practice of anesthesiologists and intensivists. Some of the questions were addressed to residents who had completed their residency and concerned their self-assessment of their level of mastery of practical skills, their readiness to act independently in critical situations, as well as their overall satisfaction with the level of their practical training upon completion of their residency.

An anonymous online questionnaire was developed for the study in the form of a Google Form titled “Practical Training in the Residency Program in Anesthesiology and Intensive Care” (URL: [https://docs.google.com/forms/d/e/1FAIpQLSfiQWzsWd050nl7Mc9lc2G5Zn-R\\_om5YVC-miPaKXSOrxFebxw/viewform?usp=header](https://docs.google.com/forms/d/e/1FAIpQLSfiQWzsWd050nl7Mc9lc2G5Zn-R_om5YVC-miPaKXSOrxFebxw/viewform?usp=header)), which was distributed on various platforms and sent to relevant departments.

## Results

A total of 291 responses were received. Among the respondents were 75 (25.8%) first-year residents, 90 (30.9%) second-year residents, and 126 (43.3%) residents who graduated between 2022 and 2025. A total of 291 respondents.

In response to the question “Did you visit the simulation center during your training?”, the following answers were received: nearly 15% of respondents answered “never,” and this group included both residents and graduates. Additionally, 9.3% of respondents (exclusively graduates and second-year residents) indicated that they visited the simulation center “only to practice skills as part of preparation for accreditation.” Thirty-seven percent of respondents reported having regular scheduled sessions, while 39% indicated that they had participated in occasional sessions focused on specific skills (no more than five per year). By comparison, a survey of residents in Romania indicated an average frequency of visiting simulation centers one to three times a month during the first two years of residency [7].

As we can see, only 37% of respondents indicated that, when learning practical skills, they first received theoretical material in the form of lectures, videos, etc., and then, under the guidance of instructors in simulation centers, practiced procedures on manikins and took a test to assess their acquired skills. 22% of respondents indicated that, after receiving theoretical material, they participated in sessions at simulation centers to practice specific practical skills without any assessment of their mastery. 28% of respondents indicated that no training in procedures was conducted at a simulation center, and skills were practiced in hospital settings on real patients. 58% of respondents received initial theoretical information on the techniques for performing procedures from instructors; additionally, 75% independently studied printed sources, and 94% of respondents studied electronic materials. Notably, 5% did not use any theoretical materials for preliminary study of the techniques for performing procedures. When asked “who conducted the sessions at the simulation center,” 76% answered “a department instructor,” 35% indicated sessions led by simulation center staff, and 31% practiced independently.

An important aspect was the detailed identification of the list of procedures that residents had previously mastered in the simulation center using manikins, as well as a comparison with procedures performed for the first time on actual patients without prior practice on manikins (Table 1). It is noteworthy that even the basic skills of an anesthesiologist-resuscitator were initially practiced in the simulation center on manikins by far from all residents, and the percentage of procedures performed for the first time on real patients without prior practice on manikins remains quite high.

Table 1

**List of procedures practiced on manikins and initially performed on real patients**

| No. | Practical skills                                                              | Practical skills that respondents practiced on manikins in the simulation center under the guidance of an instructor (%) | Practical skills that respondents performed for the first time on real patients without prior practice on manikins in the simulation center (%) |
|-----|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.  | Placement of nasopharyngeal and oropharyngeal airways                         | 59%                                                                                                                      | 40                                                                                                                                              |
| 2.  | Performing the Safar triple maneuver                                          | 51%                                                                                                                      | 49%                                                                                                                                             |
| 3.  | Ventilation via face mask                                                     | 53%                                                                                                                      | 46%                                                                                                                                             |
| 4.  | Direct laryngoscopy and tracheal intubation                                   | 70%                                                                                                                      | 30%                                                                                                                                             |
| 5.  | Indirect laryngoscopy and tracheal intubation                                 | 35%                                                                                                                      | 28%                                                                                                                                             |
| 6.  | Placement of supraglottic airways                                             | 51%                                                                                                                      | 47%                                                                                                                                             |
| 7.  | Flexible endoscopy and tracheal intubation                                    | 20%                                                                                                                      | 16%                                                                                                                                             |
| 8.  | Surgical cricothyroidotomy                                                    | 30%                                                                                                                      | 2%                                                                                                                                              |
| 9.  | Pleural puncture and drainage                                                 | 14%                                                                                                                      | 2%                                                                                                                                              |
| 10. | Subarachnoid space puncture                                                   | 43%                                                                                                                      | 39%                                                                                                                                             |
| 11. | Epidural puncture and catheterization                                         | 42%                                                                                                                      | 39%                                                                                                                                             |
| 12. | Central venous catheterization using anatomical landmarks                     | 58%                                                                                                                      | 41%                                                                                                                                             |
| 13. | Central venous catheterization with ultrasound guidance                       | 42%                                                                                                                      | 46%                                                                                                                                             |
| 14. | Arterial puncture and catheterization                                         | 4%                                                                                                                       | 66%                                                                                                                                             |
| 15. | Performing ultrasound protocols for the assessment of critically ill patients | 17%                                                                                                                      | 32%                                                                                                                                             |
| 16. | Performing a set of basic resuscitation procedures                            | 71%                                                                                                                      | 28%                                                                                                                                             |
| 17. | Performing a set of advanced resuscitation procedures                         | 71%                                                                                                                      | 25%                                                                                                                                             |

The survey examined the system for assessing skill mastery during the training process. It should be noted that 49% of respondents indicated the absence of any assessment measures to evaluate skill mastery after training; 11% indicated that they took the practical skills assessment without instructors using checklists; 40% of respondents took the practical skills assessment using checklists.

Another question regarding residents' self-assessment of their mastery of practical skills was: "From the list of procedures below, please indicate those which, in your opinion, you did not master sufficiently during your residency training." Overall, respondents indicated a confident mastery of basic skills for maintaining upper airway patency, direct laryngoscopy and tracheal intubation, performing a range of resuscitation procedures, and techniques for neuraxial anesthesia (subarachnoid space puncture). At the same time, the level of proficiency in important modern techniques remains low. For example, 57% of graduates indicated a lack of confidence in performing flexible airway endoscopy and tracheal intubation using a flexible endoscope, even though this skill is mandatory under professional standards. Thirty-five percent of residency program graduates doubt their readiness to effectively use video laryngoscopes. Similarly, 69% of respondents indicated they were unprepared to perform emergency surgical cricothyroidotomy. 31% consider themselves unprepared to perform epidural puncture and catheterization;

22% of graduates, in their opinion, have not mastered the skill of arterial puncture and catheterization; 16.5% of graduates considered their proficiency in performing ultrasound-guided central venous puncture and catheterization to be insufficient; 50% of respondents consider themselves unprepared to perform bedside ultrasound examination protocols.

An important focus of training for anesthesiology-resuscitation residents is the teaching of "non-technical skills," as well as the ability to act in critical situations using the concept of "resource management in critical situations." Mastery of these skills determines an anesthesiologist-resuscitator's ability to prevent, predict, recognize, and resolve critical situations during anesthesia and intensive care. Unfortunately, the survey results confirmed the current situation, in which these issues are not addressed by all departments during training and are not covered systematically, while expensive, highly realistic equipment is used inefficiently. Only 37% of respondents attended lectures on actions during critical situations, while 28% of those surveyed studied this topic independently. Instructors covered action algorithms for specific situations in lectures for 49% of respondents; 31% of respondents studied materials on this topic independently, either without lectures or in addition to them. Classes using highly realistic patient simulation robots to practice action algorithms were conducted with 53% of respondents.

Among the topics most frequently practiced using patient simulation robots, respondents cited: induction of elective anesthesia (56%), induction of emergency anesthesia (48%), “difficult airway” situations (56%), complications of general anesthesia (41%), hemodynamic disturbances (27%), respiratory problems during anesthesia (31%), and techniques of inhalation anesthesia (16%). Only 5% of respondents practiced managing complications of regional anesthesia, and 13% practiced anesthesia for severe trauma.

Generally similar topics (“difficult airways,” anesthesia for multiple trauma, advanced cardiopulmonary resuscitation) were most frequently practiced during resident training in various European countries, as demonstrated by a group of authors in a survey of 268 residents from 37 European countries [4]. Residents in Romania provided similar responses regarding the importance of including the topics listed above. At the same time, the surveyed residents indicated that simulation training improves their knowledge, communication skills, and ability to work in a team [7]. Interdisciplinary training on highly realistic robotic simulators was conducted with only 22% of respondents.

An objective assessment of trainees’ ability to act independently in various critical situations is an important element of the educational process. It provides an opportunity for feedback, analysis of one’s actions, and correction of identified errors. Only 41% of respondents indicated that their actions during simulated scenarios were evaluated by instructors. Only 38% of respondents underwent an evaluation of their actions while working with robotic simulators during the practical portion of their exams.

The comprehensive self-assessment of residency program graduates regarding their readiness for independent practice and their final opinion on the level of their practical training during their studies are also of great interest. The overall assessment of graduates’ satisfaction with the level of practical training regarding the mastery of procedures yielded the following results: fully satisfied—nearly 26% of respondents; partially satisfied—51%; somewhat dissatisfied—13%; and completely dissatisfied—10%. Graduates’ assessment of their readiness to perform procedures upon completion of their studies showed that 17% of the surveyed graduates consider themselves confident in performing procedures; 50% have confidently mastered the basic procedures; 27% generally possess all the basic skills but periodically experience difficulties; 6% are unsure of their skills and regularly experience difficulties when working independently. Self-assessment of readiness to act independently during critical situations is an important issue. 29% of graduates considered themselves fully prepared to act during most critical situations. 61% of respondents considered themselves somewhat prepared to act in most critical situations; 7% considered themselves somewhat unprepared to act during critical situations; and 3% considered themselves completely unprepared for such situations.

The authors conducted an additional comparative analysis of the structure of responses from graduates of different years to assess possible trends in simulation training over the past five years. A comparison of the responses revealed no significant difference in the frequency of specific response options among graduates. Given the limited sample size, the results suggest that there have been no significant changes in the practical training of anesthesiology-resuscitation residents.

## Discussion

Conducting surveys of residents regarding their experience with simulation-based training, identifying the positive and negative aspects of this experience according to respondents, and gathering their suggestions and wishes for improving the educational process is a fairly standard procedure. Surveys of this kind have been conducted among anesthesiology residents in Canada [5] and Romania [7], and pan-European studies have also been organized [4]. Taking into account the available data from the above-mentioned surveys, we were interested in analyzing the results obtained, identifying the reasons behind the respondents’ answers, attempting to assess the situation regarding practical training in the residency program in anesthesiology and critical care using simulation technologies as a whole, and comparing our data with international findings.

We found that nearly 15% of respondents (residents and graduates) answered “never” to the question “Did you visit a simulation center during your training?” Additionally, 9.3% of respondents (graduates and second-year residents) indicated that they visited the simulation center “only to practice skills as part of preparation for accreditation.” At the same time, only 37% of respondents mentioned regular scheduled classes, while 39% indicated that they had attended occasional sessions focused on specific skills. These figures indicate a persistently unsystematic approach to teaching residents practical skills and the ability to act in various clinical situations. There also remains a completely methodologically flawed practice of so-called “cramming” residents to pass the second stage of the upcoming primary specialized accreditation, rather than providing consistent, systematic training.

Only 37% of respondents described a full cycle of practical skills training (initial coverage of theoretical material through lectures, videos, etc., followed by practice on manikins under the guidance of instructors in simulation centers, and a skills assessment to verify mastery); 22% of respondents completed nearly the entire training cycle without taking an assessment or having their skill mastery evaluated, which reduces the effectiveness of training; 28% of respondents indicated that training in procedures was not conducted in a simulation center and that skills were practiced in hospital settings on real patients. Such a high percentage of residents who did not receive initial training in the safe performance of procedures on manikins and were allowed to treat real patients represents a serious violation of safety protocols in anesthesiology and intensive care and carries a high potential risk of complications.

It was also important for the survey authors to obtain comparative data on the set of practical skills initially mastered in simulation centers using manikins, and those procedures that residency graduates performed for the first time directly on patients without prior training during their residency. Analysis of the data in Table 1 revealed an overall unsatisfactory situation. The very fact that a number of procedures were initially performed on real patients without prior training on manikins during residency training does not meet modern requirements for safe clinical practice. Thus, even basic upper airway management skills (lines 1–4, 6) were mastered in the simulation center in only 50–70% of cases. Modern methods of upper airway management, the performance of which is specified in the professional standard for anesthesiologists and intensivists (use of flexible endoscopy, video laryngoscopes, and cricothyroidotomy), were mastered to a very limited extent during residency training (no more than 30% of respondents answered affirmatively). The data on residency training in basic and advanced resuscitation protocols, neuraxial anesthesia, and central venous catheterization using anatomical landmarks and ultrasound guidance are somewhat surprising. Since the responses were provided by graduates, and the aforementioned skills are part of the stations in the second stage of primary specialized accreditation, the data raise questions regarding both the organization of training and preparation for accreditation.

When examining the list of skills that graduates, in their opinion, had not mastered with sufficient confidence upon completion of residency, it is noteworthy that almost all respondents considered themselves proficient in the basic skills of maintaining upper airway patency, direct laryngoscopy and tracheal intubation, performing a complex of resuscitation measures, and methods of neuraxial anesthesia (subarachnoid space puncture). However, a significant proportion of graduates are not confident in their mastery of modern skills, and this applies to such important procedures and competencies as performing flexible airway endoscopy and tracheal intubation using a flexible endoscope, central venous catheterization with ultrasound guidance, the use of video laryngoscopes, performing emergency cricothyrotomy, and performing bedside ultrasound examination protocols. Taken together, this suggests that departments pay little attention to training in modern techniques specified in professional standards, which have already been incorporated into actual clinical practice and are critically important from the perspective of patient safety.

The above conclusion was confirmed by an analysis of information regarding the inclusion of training on critical situations in anesthesiology and resuscitation within the educational curriculum. Training in “non-technical skills” and responding to critical situations in accordance with the concept of resource management during crises is conducted in only a limited number of universities and in a non-systematic manner, while expensive, highly realistic equipment is used inefficiently. Only 37% of respondents had attended lectures on actions during critical situations, and 49% of those surveyed reported that instructors

covered action algorithms for specific situations in their lectures. Classes using highly realistic patient simulation robots to practice action algorithms were conducted with 53% of respondents. The list of clinical situations practiced using patient simulation robots is generally similar to that reported in other surveys. However, even standard topics and critical situations were studied in only half or fewer of the cases.

Thus, it can be concluded that at least half of the residents and graduates did not have the opportunity to acquire theoretical knowledge and practice skills for responding to critical situations in safe simulated conditions. The low frequency of performance evaluations of respondents during simulated scenarios is also a factor that reduces overall patient safety due to the likelihood of ineffective actions by anesthesiologists and intensivists. The need for more frequent training on critical situations and interdisciplinary training was expressed by residents in Canada in a 2010 survey [5]. Residents surveyed in a study by S. Shailaja et al. [6] described highly realistic simulation sessions positively, noting the presence of moderate stress during sessions, which ultimately increased motivation and a sense of responsibility.

The results of the final self-assessment by residency program graduates regarding their readiness for independent practice and their opinions on the level of practical training during their education showed the following: nearly 77% of respondents were fully or partially satisfied with the level of practical training; nearly 67% had confidently or generally mastered the basic procedures. At the same time, 33% of respondents feel uncertain and experience occasional or regular difficulties when performing procedures. 29% of graduates considered themselves fully prepared to act during the development of most critical situations, while 61% of respondents felt somewhat prepared to act in most critical situations. These figures raise certain questions and may indicate some overestimation of respondents’ self-assessment, given that training on critical situations was conducted with only 53% of those surveyed.

#### **Limitations of the study**

In organizing an anonymous online survey, the authors took into account all the advantages and limitations inherent in this method [1]. This survey design allowed us to collect data remotely, at a time convenient for respondents, without regional restrictions, and within a limited timeframe, while the anonymous nature of the survey potentially increases the objectivity of the responses.

One of the potential drawbacks of online surveys is sample bias and the potential for skewed responses. Undoubtedly, our study is not entirely free of these shortcomings. It is clear that we received responses from students and graduates of far from all universities in the country. Additionally, responses to some questions on the same topic, but specifically phrased differently, indicate a certain degree of inattention and inaccuracy when filling out the questionnaire. In this regard, we compared the

results obtained with published data from previous studies conducted abroad. Overall, they were comparable, which ultimately allows us to consider the results of our work to be valid and representative.

### Conclusion

The results of this study suggest that, despite the availability of material resources, human resources, and the existing system of primary specialized accreditation, practical training in the residency program in anesthesiology and intensive care does not ensure the confident mastery of all necessary practical skills for performing procedures and, equally important, does not prepare graduates, using simulation technologies, for independent work in various critical situations. Furthermore, the study's findings suggest that, due to a combination of well-known and as-yet-unresolved issues, expensive, highly realistic equipment is not being fully utilized in educational institutions, which also reduces graduates' readiness for independent clinical practice.

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