SCIENCE AND TECHNOLOGY

PART TWO

2-PART FEATURE

Educational Theories and Practical Applications of Simulation for Anesthesia Technologists

Part II: Practical Applications of Simulation for Anesthesia Technologists

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INTRODUCTION

Simulation for anesthesia technologists and technicians should extend beyond theoretical foundations to meaningful, practice-based application. While Part One established the role of educational theory, this section focuses on how simulation can be operationalized in two distinct but complementary contexts: in situ simulation and academic simulation centers. Both approaches create opportunities to strengthen the skills, confidence, and interprofessional integration of anesthesia technologists and technicians. Simulation's value lies not only in teaching isolated technical skills but also in scaffolding the teamwork, advocacy, and critical thinking required in today's operating rooms.

IN SITU SIMULATION

In situ simulation occurs in the actual clinical environment, for the anesthesia team this is typically the operating room (OR) or perioperative areas (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022). What makes In-Situ simulation valuable is that it has a direct connection to the clinicians working environment utilizing the supplies and equipment that they use in their practice as it occurs where they work. Its other advantage is that with comfortability of space, this type of simulation environment maximizes physical fidelity and environmental fidelity to identify how teams work and what gaps may exist in the care continuum (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022). It reinforces familiarity with clinical environments, workflows, and communication patterns. Importantly, it highlights latent safety threats, revealing process vulnerabilities that might otherwise remain hidden (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022).

In situ simulation aligns particularly well with Bandura's Social Learning Theory (observation and modeling) and Kolb's Experiential Learning Cycle (concrete experience in the actual OR space). Learners see, do, and reflect in the very context in which their future work occurs, making transfer of skills to practice seamless.

Task trainer for anesthesia:.
(U.S. Navy Photo by Petty Officer 3rd Class Ariana Torman/Released)

APPLICATIONS FOR ANESTHESIA TECHNOLOGISTS TO USE IN SITU SIMULATION

For working anesthesia technologists, simulation becomes most meaningful when it mirrors the challenges of daily practice. These challenges range from routine equipment checks to rare but life-threatening emergencies, all of which require both technical precision and effective communication. By situating technologists within realistic, high-pressure scenarios, simulation creates opportunities to practice critical skills in a safe but authentic environment.

One of the most common areas of application is equipment management and troubleshooting. In the operating room, machines are the lifeline of patient care, and even a brief disruption can have significant consequences. Imagine a simulated power failure in the OR: the anesthesia technologist is suddenly faced with the need to switch to backup systems, confirm oxygen supply integrity, and coordinate with biomedical staff to restore functionality. This type of scenario highlights their role as the first line of defense for equipment reliability. By practicing in the exact environment with the same machines they use daily, technologists gain the confidence to troubleshoot quickly and accurately under pressure. This type of scenario not only highlights a core skillset essential to anesthesia crisis resource management, but also creates an opportunity to demonstrate to other members of the anesthesia care team and the broader operating room staff what must occur for the process to be carried out safely and successfully. This provides an opportunity not only to conduct simulation within the anesthesia technology team, but also to expand into interdisciplinary scenarios that link multiple teams together, fostering a more coordinated and effective response to future events.

Another critical application lies in crisis resource management. Rare but high-stakes events, such as malignant hyperthermia, demand a rehearsed and coordinated response (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022). In a simulated intraoperative emergency, the anesthesia technologist may be required to retrieve and prepare dantrolene, set up cooling devices, and provide immediate support to the anesthesia provider. These scenarios ensure technologists are not only familiar with supply locations and processes but also prepared to act without hesitation when seconds count. Because such events may occur only once in a career, or never at all, simulation offers a safe yet realistic environment to practice readiness and reinforce the technologist's critical role in crisis management.

Equally important are the communication skills that protect patient safety in everyday practice. In many ORs, hierarchical structures can make it difficult for technologists to voice concerns, even when they identify potential risks. Simulation provides a unique space to rehearse advocacy and interprofessional communication (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022). For instance, in a scenario where a machine check is skipped before induction, the technologist must speak up, challenging a potential safety lapse. Practicing these conversations within simulation builds assertiveness, reinforces the importance of psychological safety, and prepares technologists to advocate confidently in real situations where their input could prevent harm.

Finally, workflow integration provides another rich opportunity for simulation-based learning. Rapid turnovers between cases are common in busy surgical environments, and anesthesia technologists must manage this transition efficiently without sacrificing safety. A simulation of back-to-back procedures, for example, might require the technologist to reset the anesthesia machine, suction, scavenging, and monitoring systems quickly while also coordinating with nursing staff preparing the next patient (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022). This type of scenario strengthens the technologist's ability to work under time pressure, prioritize essential tasks, and communicate seamlessly with the perioperative team. The result is greater confidence in handling one of the most fast-paced aspects of OR practice.

Through these varied applications, equipment troubleshooting, crisis response, advocacy, and workflow integration, simulation becomes a powerful tool for preparing anesthesia technologists to meet the demands of modern surgical care. Each scenario not only builds technical skill but also reinforces the confidence and communication strategies needed to thrive in high-stakes environments where patient safety depends on their expertise.

The learning theories outlined in Part One come to life most effectively through in situ simulation, where anesthesia technologists practice within the real operating room environment. Kolb reminds us that learning begins with concrete experience and reflection, while constructivism emphasizes scaffolding and authenticity, both of which are inherent in simulations that mirror daily work. Adult learning theory stresses relevance and self-direction, which in situ practice provides by showing technologists exactly why and how their skills matter in patient care. Finally, Bandura's social learning theory highlights the importance of observation, modeling, and teamwork, all of which are amplified when interprofessional teams participate together. Thus, the theories do not remain abstract but are embodied in real-world, practice-based scenarios that prepare anesthesia technologists for the complexity and unpredictability of the operating room.

ACADEMIC SIMULATION CENTERS: DEFINITION AND VALUE

Academic simulation centers serve as structured, purpose-built environments designed to support skill development, critical thinking, and professional growth. For anesthesia technologists, these centers offer a unique opportunity to practice deliberately, repeat tasks, and engage with fidelity at a level appropriate to their stage of learning (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022). Unlike in situ simulation, which unfolds in the real operating room under

Photo credit: Stanford EdTech

the shadow of patient care pressures, simulation centers provide the freedom to experiment, reflect, and learn from mistakes without consequence. They also give faculty the flexibility to scaffold complexity intentionally, ensuring that learners actively construct knowledge through problem-solving in a supportive setting (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022).

APPLICATIONS FOR ANESTHESIA TECHNOLOGISTS

Within academic centers, anesthesia technologists can progress from foundational skills to highly complex scenarios. Task trainers create space for deliberate practice of psychomotor skills such as scavenging system setup, IV fluid warmer assembly, or suction configuration, essential competencies that benefit from repetition and feedback (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022). Beyond these building blocks, simulation centers allow technologists to engage in complex, scenario-based training. For instance, rehearsing the management of an obstetric hemorrhage requiring cell saver setup and communication with the blood bank ensures readiness for rare but high-stakes situations.

Academic centers also expand the scope of training through standardized patient and hybrid simulations. These experiences develop communication and empathy skills, such as explaining equipment to anxious pre-operative patients, skills that can be easily overlooked when training focuses solely on technology. Finally, simulation centers support longitudinal curriculum development by sequencing training across an entire program: beginning with early machine checks, advancing into interdisciplinary teamwork by mid-program, and culminating in high-stakes crisis management before graduation (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022).

Task trainer:. Photo credit: Magnus Manske

RECOMMENDATIONS FOR IMPLEMENTATION

To maximize impact, simulation within academic centers must be fully embedded in the anesthesia technology curriculum rather than treated as optional enrichment. Fidelity should be applied intentionally, with low-fidelity approaches supporting repetitive task practice and high-fidelity approaches reserved for complex, integrative crises (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022). Faculty development is essential, particularly in debriefing strategies such as advocacy-inquiry or plus-delta, which ensure that learners derive meaning and growth from each session. In addition, linking simulation performance to accreditation standards and certification competencies ensures accountability and demonstrates value to both learners and institutions (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022).

SCAFFOLDING FOUNDATIONAL PRINCIPLES INTO PRACTICE

Simulation for anesthesia technologists should follow a scaffolded approach that spans both academic centers and in situ environments. Training begins with isolated psychomotor tasks in the lab, then advances to integrated workflows within simulated OR environments, and ultimately culminates in interdisciplinary, high-stakes events conducted in situ (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022). Across this progression, alignment with both technical skills (e.g., machine checks, cell saver setup) and non-technical skills (e.g., advocacy, teamwork) ensures that learners meet both academic and clinical expectations. Debriefing is tailored to context: in academic centers, it emphasizes skill development, theory integration, and reflection, while in situ debriefs focus on communication patterns, systems barriers, and latent safety threats (Jeffries, 2020; Levine et al., 2014; Maxworthy, 2022). Together, these approaches create a comprehensive training pathway that blends theory with practice, preparing anesthesia technologists for the realities of their role in the operating room.

CONCLUSION

Simulation for anesthesia technologists and technicians is most effective when it bridges theory with practice across academic centers and in situ environments. Academic centers provide structured spaces for scaffolding skills, layering complexity, and building confidence through deliberate practice. In situ simulations extend that learning into the operating room, exposing latent safety threats, reinforcing teamwork, and situating skills directly in the clinical context where patient care occurs.

Together, these approaches create a continuum of professional development, progressing from isolated task training, to integrated workflows, to interdisciplinary crisis management. Theoretical frameworks such as Kolb's experiential learning cycle, constructivism, adult learning theory, and Bandura's social learning theory come to life in these scenarios, guiding reflection, problem-solving, and collaboration.

By integrating academic and clinical simulations, anesthesia technologists emerge not only technically proficient but also prepared with the advocacy, communication, and critical thinking skills essential for safe and effective practice. This fusion of theory and application establishes simulation as a cornerstone of anesthesia technology education, ensuring graduates are equipped to meet the complexity, urgency, and collaborative demands of modern surgical care.

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Continuing Education Quiz

To test your knowledge on this issue's article, provide correct answers to the following questions on the form below. Follow the instructions carefully.

1. In situ simulation is primarily conducted in:
A) Purpose-built academic centers
B) Operating rooms or perioperative environments
C) Classrooms with task trainers
D) Virtual-only platforms

2. Which of the following is a primary advantage of in situ simulation?
A) It eliminates the need for equipment management training
B) It maximizes environmental and physical fidelity by using real OR spaces
C) It reduces interprofessional collaboration
D) It is easier to control than academic centers

3. Which rare but life-threatening event is frequently rehearsed in anesthesia crisis simulation?
A) Sepsis
B) Pulmonary embolism
C) Malignant hyperthermia
D) Myocardial infarction

4. In situ simulation helps uncover:
A) Standardized exam content
B) Latent safety threats in workflows
C) Exclusive reliance on textbook knowledge
D) Simplified communication protocols only

5. Academic simulation centers differ from in situ simulation because they:
A) Replicate clinical spaces exactly
B) Allow learners to practice deliberately and repeatedly without patient pressure
C) Remove the need for debriefing
D) Provide higher fidelity than real ORs

6. Which task might anesthesia technologists practice on task trainers in simulation centers?
A) Diagnosing malignant hyperthermia
B) Scavenging system setup or suction configuration
C) Interprofessional advocacy
D) Scheduling OR turnover

7. What unique opportunity do academic centers provide that in situ cannot?
A) Exposure to latent threats in real workflows
B) Immediate patient care integration
C) Freedom to fail and learn without patient consequences
D) Real-world familiarity with OR environments

8. Effective simulation curriculum design requires:
A) Treating simulation as optional enrichment
B) Aligning with accreditation and certification standards
C) Minimizing debriefing to save time
D) Using only high-fidelity simulation in all cases

9. In debriefing, the emphasis in in situ simulation is often on:
A) Technical psychomotor repetition only
B) Communication patterns and system barriers
C) Reducing scenario realism
D) Individual competition among learners

10. The article concludes that simulation should be treated as:
A) An optional supplement to clinical practice
B) A secondary tool when live cases are unavailable
C) Essential infrastructure for anesthesia technology education and competence
D) A one-time orientation exercise for students

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1.	A	B	C	D	6.	A	B	C	D
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3.	A	B	C	D	8.	A	B	C	D
4.	A	B	C	D	9.	A	B	C	D
5.	A	B	C	D	10.	A	B	C	D

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