The use of simulation to imitate real-life scenarios reaches back many centuries. In the last decade, the use of simulation in healthcare has gained acceptance as a valuable tool for teaching and learning technical and nontechnical skills in healthcare. The use of simulation technology has moved medical education from the standard of pen and paper examinations to the assessment of clinical competency before caring for patients. The old thinking of “see one, do one, teach one” is behind us as healthcare works to create a culture of safety that holds healthcare personnel accountable. A current use of testing clinical competence is the use of Objective Structured Clinical Examination (OSCE) by physician training programs. As a testing tool, the OSCE has great potential to assess the clinical competence of students before they enter the clinical setting. The nurse anesthesia program at the authors’ university has moved toward creating a formal assessment to ensure clinical competence of their student registered nurse anesthetists. In this article, we describe the development and implementation of an OSCE to ensure clinical competence of first-year student registered nurse anesthetists before they begin their clinical training.

Keywords: Assessment, formative, Objective Structured Clinical Examination, simulation, summative.

Simulation-based training has revolutionized many professions. The aviation industry adopted the use of simulation training when it realized that a large number of aircraft accidents were caused by the lack of proper training of the pilots in nontechnical skills. High-reliability organizations such as the aviation industry have paved the way for the use of simulation training in healthcare. Just as airline passengers expect high performance from their pilots, patients are expecting the same from healthcare providers. The increased focus on patient safety and greater accountability has caused a paradigm shift. This shift has led to the use of simulation training and a curriculum that is competency based, with a rigorous method for evaluating clinical skills.

The growing use of simulation to evaluate clinical skills bridges the gap between what is learned in the classroom and the skills performed on a live patient. The dynamic decision making that occurs during an anesthetic can be simulated on high-fidelity mannequins, allowing the students to practice and work independently through a scenario. The use of simulation to practice technical skills has gained acceptance as a viable teaching and learning method in healthcare.¹

The paradigm shift in healthcare has led to the use of simulation to perform summative assessments of the students’ clinical skills. A method being used at our southeastern US nurse anesthesia program is the Objective Structured Clinical Examination (OSCE) to determine clinical competency in first-year student registered nurse anesthetists (SRNAs). The OSCE has the potential to assess what was learned
in the classroom and in practice during simulation laboratory exercises ("labs"). Educators in the field of medicine view the OSCE as a gold standard for practitioner competency assessment.2 The OSCE is an assessment tool that can be incorporated into nurse anesthesia programs to meet the current needs in healthcare of ensuring clinical competence of students before entering the clinical setting and caring for patients.

Assessment and Clinical Performance

Miller’s pyramid model can be used to describe the clinical journey of a healthcare provider from novice to expert. The model stages are “knows, knows how, shows how, and does.” Cognition is assessed with “knows and knows how”; these stages are usually assessed by the use of summative assessments. The stage of “shows how” is where instructors can use OSCEs to assess students’ demonstration of learning.3 The real-world “does” is at the peak of Miller’s pyramid, and this is manifested by the students performing the skills learned in clinical practice.

In our nurse anesthesia program, the current method of assessing Miller’s stage of “does” is by faculty members’ direct observation of student performance in the clinical setting. The faculty and clinical preceptors document in the students’ clinical evaluation books whether the clinical objectives were met by indicating “met” or “not met.” This indirect method of evaluating a student’s clinical performance does not ensure that they were technically competent before exposing patients to the risk of procedures performed by novice students.

The evaluation of Miller’s stage “shows” is being achieved by incorporating simulation training into the nurse anesthesia program. Weekly objectives are created for the simulation learning exercises, which parallel the didactic and clinical objectives. During the simulation labs, the students are observed directly by faculty, and their fellow classmates participate and observe the simulation exercises. After the simulation scenarios are completed, the students participate in a debriefing session to discuss their performance in the simulation exercises. According to Cook et al,4 technology-enhanced training simulation is associated with improved outcomes, compared with no intervention, for healthcare professionals across a range of clinical topics and outcomes in patient care.

The OSCE has real potential to complement the traditional educational model that includes reading and lecture, gaining psychomotor skills through the laboratory setting, and practicing on live patients in the clinical arena. According to Issenberg et al,5 high-fidelity medical simulations are educationally effective, and simulation-based education complements medical education in patient care settings. The incorporation of the OSCE into our nurse anesthesia program could effectively shape the clinical performance of future nurse anesthetists.2

Objective Structured Clinical Examination

Traditionally, classroom instruction using summative assessment has been the standard to test students’ knowledge of the course objectives.6 Summative assessment occurs with classroom instruction, followed by semester examinations, final examinations, and/or standardized examinations. This method of teaching is a point-in-time assessment and lacks the ability to assess the students’ ability as learning occurs. In contrast, formative assessment occurs in the present as learning is taking place. This allows for the ability to change and adjust teaching methods as they occur. Various methods of formative assessments include student participation, self-assessment, and peer assessment.7

Formative assessments alone lack the ability to incorporate what is necessary to evaluate students in clinical practice. A formative approach is needed for students to learn and practice clinical objectives before a summative assessment is administered. However, when it comes to evaluating educational outcomes, a summative assessment is the appropriate method to assess the performance of the learners by re-creating clinical situations with the aid of simulation technologies.

The OSCE was developed to assess clinical competence. This summative methodologic approach is intended to decrease variables, limit complexity, and clarify objectives to test students’ knowledge.8 The structural component focuses on the clinical objectives reflected in a checklist format. The ability to first practice what is taught and then be tested in a standardized fashion is a unique attribute of the OSCE.

Simulation-based education using an OSCE format incorporates both summative (examination checklist) and formative (feedback) assessments to accomplish clinical competencies in real time.9 This educational formatting provides “scaffolding”—individualized instruction that not only measures summative outcomes but also can identify areas for improvement, self-reflection, and goal achievement.10 It also allows for the practice of anesthesia procedures, from routine to low-frequency, high-acuity clinical situations, before caring for a real patient.11

The OSCE format is used in clinical practice in many disciplines. In the United States Medical Licensing Examination Steps 1 to 3, the OSCE is used to measure clinical competence and progression from basic to clinical sciences. This OSCE typically consists of 12 stations, 15 minutes each.3 The entire examination concludes in 8 hours with 2 breaks. In nursing, Bournemouth University in Dorset,
UK, has developed and adopted the OSCE for testing nurse practitioner students’ clinical competence at the end of the first year of a 2-year program. In anesthesiology, the Israeli National Board of Examination has incorporated the OSCE for testing the competency of trauma management, resuscitation, crisis management, regional anesthesia, and mechanical ventilation. Furthermore, an evidence-based practice OSCE station was developed for family medicine residents. Participants in this study were 23 first-year residents and 19 second-year residents. Testing consisted of 6 OSCE stations that included patient interview, clinical focus, interpretation of laboratory findings, differential diagnosis, ethics, and confidentiality. The results were positive: content validity (feedback from expert opinion), construct validity (P = .043), criterion validity (P < .001), interrater reliability (.96 for checklist, 0.92 for global score), and internal reliability (Cronbach α acceptable at .58). The OSCE testing is gaining increasing popularity for summative evaluations that integrate simulation technological abilities to accomplish clinical competencies across many clinical professions.

Simulation-Based Education
From inception of this southeastern US nurse anesthesia program in 2001, the faculty has continuously planned for the integration of simulation-based education into the curriculum. Initial simulation instruction consisted of skills training for patient assessment, airway management, and regional anesthesia for the first-year students as well as simulation in anesthesia crisis management for the second-year students. In 2004, the program relocated to the university’s main campus, and it subsequently created a 3,600-m² (40,000-sq ft) virtual acute care hospital with surgical suites featuring 4 operating rooms. Operating rooms are equipped with 4 high-fidelity mannequins (Laerdal Medical), each complete with an anesthesia machine, anesthesia cart, surgical equipment, and overhead video recording capability. The simulation spaces in the center were all designed to have the look, feel, sounds, and furnishings of an actual patient care facility, although all of the patients are mannequins or actors used for instruction, evaluation, and research.

The education of the nurse anesthesia faculty in simulation-based education has been a priority for the implementation and management of the simulation center. Each faculty member is continually updated in simulation instructor training in the university and at other universities, simulation centers, and conferences, and as facilitators for simulation instruction courses. The faculty’s expertise in simulation is required for the integrated faculty assignments, which include 3 weekly instruction modalities: didactic, simulation, and clinical site education of the SRNAs.

By 2010, the nurse anesthesia curriculum was revised to integrate 350 hours of simulation-based education throughout the curriculum in parallel with each of the main anesthesiology nursing courses. Across the simulation instruction sessions, the students progressed from task training, to procedural integration, to clinical integration scenarios, each with their own prelearning activities, practice sessions, debriefings, and formative assessments. Although we have had separate formative scheduled simulation sessions, there was no formal process that would require the student to carry out all those individual skills and tasks together to a predefined end point that included summative evaluations.

Methods
In 2012, the process began for the development of an OSCE for the simulation-based educational portions of the curriculum. The goal was to develop OSCEs for all the clinical performance objectives from semester 1 through semester 7, which completes the integrative educational design. This integrative approach provides the scaffolding—a formative educational platform—to the implementation of OSCEs that mirrors and complements other types of traditional testing, such as written examinations.

• Facility and Equipment.
Access to a simulation facility or its equivalent is essential for successful implementation of a clinical testing program. The Simulation Training And Research (STAR) Center at the university provides our SRNAs with dedicated access. Technical and personnel support from the STAR Center’s employees and undergraduate nursing students was essential to implement this project.

The mannequin used for the implementation of the OSCE stations was SimMan 3G (Laerdal Medical). The anesthesia delivery system was the GE Healthcare Aestiva/5. Other anesthesia-related equipment found in an operating room suite, including intubation equipment, a variety of airways, labeled syringes, suction, operating room tables, and stretchers, were also used.

The assistance of the STAR Center personnel was instrumental in the implementation of testing. A script was developed for each OSCE station for the STAR Center’s personnel. The center’s personnel participated as standardized patients for the preanesthetic evaluation station and in the OSCE stations as ancillary personnel. The STAR Center’s technical personnel received a script to run the simulators according to the needs of the OSCE scenario for the physiologic responses of the simulator.

During the planning process, it was decided that the stations were to last no longer than 15 minutes for logistic reasons. A total of 35 students were allocated to a schedule
between 2 days. Each day, groups of 5 students were scheduled at 1.5-hour intervals. This arrangement permitted a 15-minute scripted orientation that was given to all groups before the start of testing. In this orientation session, participants were instructed on how the testing was going to take place and the station rotation they were assigned to, and were asked to verbalize their actions to facilitate scoring.

The 5 stations (see the next section) were set up in 5 different adjacent rooms that had the capability of being isolated from each other to eliminate distractions to the students. Each testing room had the station number and name as well as a brief description of the scenario. The student had at least 2 minutes to read the information. If a student finished ahead of schedule, he or she stayed in the station until every student was finished. The students were then allowed to proceed to the next station, where they read the instructions pertaining to that testing station. At a signal given by the timekeeper, the students entered the station and carried out the task for that station.

A faculty proctor who had developed the scoring rubric (see later section, “Development of Rubrics”) scored each station. If the faculty member rating the performance needed to communicate with the participant of a station during the testing, a microphone with a speaker mounted in the ceiling of the station was used. The participant could also communicate with the faculty member in the same way. All observation of performance and ratings were made in specially designed rooms with 1-way mirrors that allowed full observation of performance. Performances were also videotaped using 3 fixed cameras. Objects in the room were arranged to maximize camera views. The cameras were set at fixed angles but had the capability of changing angles and zooming in to a high degree of detail. A separate person was used to manage the camera views at the discretion of the faculty rater and the operator of the simulation equipment.

It is of the utmost importance to test the equipment and practice with the staff well in advance of the actual day of testing to work out any issues that may arise before testing day. The so-called “dry run” of every station is highly recommended for obvious reasons.

- **Development of Stations.** The OSCE stations and skills to be evaluated were developed in conjunction with expert faculty in the university and in consultation with the clinicians at our clinical practice sites. Each OSCE station was guided by the essential clinical objectives that had been determined for first-semester nurse anesthesia students in each simulation laboratory (Figure 1). The input and suggestions from the clinical sites were then evaluated, and 5 OSCE stations were developed. The skills assessed in the 5 OSCE stations need to be mastered by the students for them to progress into the next semester of clinical education. Mastery of these particular skills should enhance the students’ chances of a smooth transition from an observational role in the first semester to a more active role in the second semester, therefore providing a foundation for safe practice.

The 5 stations were as follows:
1. Anesthesia equipment check (including anesthesia delivery system)
2. Preanesthetic evaluation examination
3. Masking and airway adjuncts
4. Patient transfer and positioning
5. General anesthesia induction, including rapid-sequence induction

- **Development of Rubrics.** Once the 5 testing stations were agreed on, the task of rubric development began. Each member of our doctoral-prepared faculty has at least 8 years of clinical practice experience and at least 5 years of nurse anesthesia education experience. Each faculty member was assigned 1 of the 5 OSCE stations for rubric development. Objectives originating from the current first-semester simulation laboratory sessions initiated the process. Delphi methods began with a review of literature, including a traditional textbook (Basics of Anesthesia) and anesthesia journals, for current evidence-based practice.

After the first draft of the rubric was created, each faculty member received a copy of the rubrics for all the OSCE stations for evaluation. The faculty met for a group view of each of the rubrics for discussion of the items in agreement or disagreement. After the differences were evaluated, the rubrics were modified as outlined in the group meeting. This process was repeated until total agreement was reached. In this process, the faculty identified critical clinical skills that were the necessary elements for the SRNA to successfully complete the OSCE station. Review and critique by other nurse anesthesia faculty members was an integral part of the process. Rubrics were transferred to a computerized software program for scoring and tracking. Additional OSCEs have been developed for team training for senior students (Figure 2).

### Lessons Learned

Our faculty experiences with this premier testing can be used for future implementation and development of OSCE stations. A key component in planning is to include extra time for unforeseen (technical) events when scheduling the students for the OSCE intervals. Once the times for the OSCE stations are plotted, adhering to a strict time limit, whether or not the student finished the objectives of the OSCE, is crucial to complete the testing of all the students.
Figure 1. Each OSCE station was guided by the essential clinical objectives that had been determined for first-semester nurse anesthesia students in each simulation laboratory.
Abbreviation: OSCE, Objective Structured Clinical Examination.

Figure 2. OSCE testing has been expanded to include individual skills assessment, as well as team performance.
Faculty scheduling along with the number of faculty needed for OSCE testing is also critical. The 5 OSCE stations were under the direction of 1 faculty member per station to ensure consistency and to troubleshoot should a problem arise. Because of the prior planning and well-executed coordination with the STAR Center director and staff, the whole logistical experience was cohesive and effortless. Therefore, diligent preparation, planning, and communication among all stakeholders provide the foundation for a successful OSCE simulation.

Technical factors need to be addressed for the implementation of OSCE testing. First, the number of stations must be kept manageable and realistic according to availability of the resources. Second, equipment malfunctions were a concern, and when they occurred, the faculty had to improvise and verbally direct the student to overlook the malfunction. This distraction from the simulation was confusing because some students reacted as if the malfunction was part of the OSCE. It is also important to plan for an alternative mannequin for the OSCE station in case of a malfunction. Educators might consider using standardized patients with a rehearsed script because they are reliable, predictable, and valuable for some OSCE stations (Figure 3).

A day of testing is exhausting for both faculty and personnel assisting as actors, standardized patients, or running the equipment. Scheduling a smaller group (eg, 4 instead of 5 students) allows for a 15-minute break per station while minimally disrupting the flow and number of students that can be tested in a day.

Conclusion
Simulation training continues to gain in popularity and is a crucial component in anesthesia training today. Nurse anesthesia educators continue to investigate the best methods for summative and formative evaluation of its students. In the current healthcare climate, the emphasis has moved toward patient safety and quality outcomes. This necessitates a move toward the use of assessments that are high in quality and reliable. The direct observation of SRNAs in clinical simulation allows the assessment of clinical skills that the traditional pen and paper do not afford. The use of OSCEs as a summative evaluation tool at the conclusion of a semester can provide an assessment of the SRNA’s acquisition of skills. The benefits of the OSCE for the faculty, learners, clinical sites, and patients are insurmountable.

In this OSCE experience, number and type of stations were reviewed by the faculty and the anesthesia personnel at the clinical sites before development of the checklist. This process is an attempt to provide content validity, however; there was not a formal review that included

**Figure 3.** Educators might consider using standardized patients with a rehearsed script because they are reliable, predictable, and valuable for some OSCE stations.

Abbreviation: Objective Structured Clinical Examination.
a panel of external experts. Future OSCE development should include a comparison of different levels of SRNAs (eg, second-year students) to establish construct validity of the checklist. A midsemester OSCE with a comparison OSCE at the end of the semester can show a progression of growth or establish adequate skill achievement and/or identify areas of improvement for the SRNA before the semester ends. Because the results of the OSCE will be used for high-stakes decisions, the faculty should feel confident in the results.

The success of the OSCE requires substantial planning, coordination, and the use of multiple resources. Because the OSCE may be the determining factor in a student’s success in his or her program of study, there must be valid evidence to justify the use of the OSCE. More research is needed about how to best use the information gathered after OSCE testing and to ensure reliability and validity of the testing modality. Although institutions should avoid relying solely on the OSCE to make judgment on a student’s success in his or her program of study, it should be an integral piece of the puzzle when evaluating a student’s clinical competence. At our southeastern US nurse anesthesia program, the missing piece of the puzzle is being filled in, by ensuring that our students have acquired the technical and nontechnical skills necessary to provide safe care to patients.

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