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Recertification and Reentry to Practice for Nurse Anesthetists: Determining Core Competencies and Evaluating Performance via High-Fidelity Simulation Technology

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Abstract

Introduction

The National Board of Certification and Recertification for Nurse Anesthetists addressed a barrier to return to practice of uncertified practitioners by replacing required direct patient care experiences with high-fidelity simulation.

Objectives

The aims of this study were to: (a) validate a set of clinical activities for their relevance to reentry and determine if they could be replicated using simulation, (b) evaluate the content validity of an existing simulation scenario containing the proposed clinical activities and determine its substitutability for a clinical practicum, and (c) evaluate the validity of two methods to assess simulation performance.

Methods

A modified Delphi method incorporating an autonomous, anonymous, three-round online survey process using three unique expert certified registered nurse anesthetists groups was used to address each study aim.

Results

Twenty-seven clinical activities gained consensus as necessary to be assessed in the simulation. All 14 survey questions used to determine simulation content validity exceeded the minimum content validity index (CVI) value of 0.78, with a mean CVI of 0.99. The global rating scale CVI and the competency checklist CVI were 0.83 and 1.0, respectively.

Conclusion

The findings add to the existing literature supporting the utility of simulation for high-stakes provider assessment and certification.

Keywords

CRNA, reentry to nursing practice, simulation for recertification

Certified registered nurse anesthetists (CRNAs) have acquired a sound reputation among medical professionals for excellence in anesthesia care. They maintain quality care through the ongoing acquisition of knowledge, the application of established expert standards, and the continued maintenance of certification. Requirements for certification are established by the National Board of Certification and Recertification for Nurse Anesthetists (NBCRNA). Certification and maintenance of certification programs (formerly known as recertification) provide evidence that anesthesia providers have obtained both the skills and the knowledge necessary to deliver safe and effective care. These programs have effectively served their intended purpose; however, the established criteria for recertification and reentry to practice of nurse anesthetists previously holding the CRNA credential have led to considerable barriers to success. The greatest of these barriers is the requirement for a direct patient care experience (NBCRNA, 2015).

Throughout a CRNA's career, situations may arise that require an extended leave of absence with a resultant lapse in provider certification. The former NBCRNA-administered reentry process, known as the "Refresher Program," provided a means for CRNAs to recertify and reenter practice upon the completion of continuing education credits, clinical anesthesia experiences within an accredited medical facility, and the successful completion of the National Certification Examination (NBCRNA, 2015). The number of continuing education credits and clinical hours required were based on the length of time a nurse anesthetist had been out of practice. For example, a nurse anesthetist desiring to reenter practice after taking a leave of absence from clinical practice for fewer than 5 years would require 200 clinical hours to complete the Refresher Program. Unfortunately, institutions were reluctant to grant practice privileges to uncertified nurse anesthetists enrolled in the Refresher Program (L. Thiemann, NBCRNA Staff, personal communication, August 2015), making the required clinical portion of the program unobtainable. Such circumstances rendered skilled practitioners unable to reenter practice and reduced the availability of quality, affordable anesthesia care (L. Thiemann, NBCRNA Staff, personal communication, August 2015). Although the population of nurse anesthetists seeking reentry to practice is relatively small, approximately 25 to 50 people per year, the NBCRNA responded to this problem by replacing the Refresher Program with the Reentry Program in August 2016 (NBCRNA, 2017). The Reentry Program requires the completion of continuing education credits, four topic-focused modules critical to nurse anesthesia care, a standardized examination, and high-fidelity patient simulation as a substitute for direct patient care clinical hour requirements. To support this program change, we collaborated with the NBCRNA to accomplish the following: (a) identify activities necessary for reentry into practice, (b) validate the use of high-fidelity simulation in place of direct patient care to satisfy the clinical requirement, and (c) examine the validity and reliability of two simulation evaluation tools for use in high-stakes simulation-based assessment.

Literature Review

Although the use of simulation for provider credentialing is not universally required, it is highly valued as an educational training and assessment tool and has been mandated by some accreditation bodies (Steadman & Huang, 2012). In its 2011 report *The Future of Nursing*, the Institute of Medicine endorsed the innovative and educational techniques of simulation and viewed it as a key component for assessing competency. Furthermore, a randomized controlled study by the National Council of State Boards of Nursing (Hayden, Smiley, Alexander, Kardong-Edgren, & Jeffries, 2014) found no significant difference in the clinical competency ($p = .688$), comprehensive knowledge assessment ($p = .478$), or National Council Licensure Examination pass rates ($p = .737$) of nursing students who had up to 50% of their traditional clinical experiences replaced with simulation compared with nursing students who completed traditional clinical hours. These findings support the potential for simulation to serve as a substitute for clinical experiences without hindering provider performance. Although simulation-based education has been shown to be effective in the cognitive, affective, and psychomotor domains of learning (Lioce et al., 2013), the process of evaluating clinical competence in a simulation setting is complex and lacks consensus. Current competency-evaluation strategies are frequently subjective in nature, and inconsistencies among evaluator expectations often make it difficult to standardize the evaluation process (Hayden, Keegan, Kardong-Edgren, & Smiley, 2014). Competency evaluation tools frequently

take the form of checklists or global rating scales (GRS). Checklists are thought to minimize rater subjectivity, are intuitive to use, and contain directly observable behaviors (Ilgen, Ma, Hatla, & Cook, 2015; Turner et al., 2014). In contrast, GRSs do not limit evaluators to specific behaviors but allow them to provide broader evaluation of provider performance and can often identify varying levels of competency (Ilgen et al., 2015; Turner et al., 2014). Unfortunately, the elements of the GRS require subjective rater judgement, which means the reliability of the instrument is dependent upon the evaluators' expertise and familiarity with the evaluation tool (Turner et al., 2014; Ilgen et al., 2015).

The Creighton Competency Evaluation Instrument (C-CEI) is a GRS-type evaluation tool that was developed for the National Council of State Boards of Nursing National Simulation Study (Hayden, Smiley, Alexander, Kardong-Edgren, S., & Jeffries, 2014). The tool has four domains including assessment, communication, clinical judgment, and patient safety with behaviors specific for each domain, resulting in a total of 23 behaviors (Hayden, Keegan, Kardong-Edgren, & Smiley, 2014). Although the C-CEI is a valid and reliable means of evaluating the competency of prelicensure nursing students, its ability to evaluate nurse anesthetists' competency in high-stakes simulation scenarios has not been studied. In fact, little research has been conducted to evaluate the validity and reliability of checklists or GRS for use in evaluating nurse anesthetists' clinical competency. Therefore, a valid and reliable evaluation tool for simulation-based high-stakes evaluation of nurse anesthetists needs to be identified.

In this study, we describe our work to identify activities that can be assessed via simulation, attempt to validate the appropriateness of substituting simulation in lieu of direct patient care, and examine new and existing evaluation tools to assess the simulation performance of the CRNA seeking reentry to practice. The specific aims were to:

1. Establish expert consensus for the clinical activities necessary for consideration for medical staff credentialing and privileging proposed by the NBCRNA for eligibility for reentry to practice and assess whether those activities identified by the expert panel could be replicated with the use of high-fidelity simulation
2. Evaluate the content validity of an existing simulation scenario containing five of the proposed clinical activities and determine the appropriateness in using a simulated assessment as an alternative to a clinical practicum for high-stakes assessment of reentering nurse anesthetists
3. Evaluate the content validity and reliability of the C-CEI and a competency checklist for use in high-stakes evaluation of nurse anesthetists seeking to reenter practice.

Theoretical Model

The Delphi method was developed in the 1950s by the RAND Corporation and has historically been used to forecast the effects of technological warfare. It has since been widely adopted by many fields of science and is still commonly used (RAND Corporation, 2016). The Delphi method "solicits the opinions of experts through a

series of carefully designed questionnaires interspersed with information and opinion feedback in order to establish a convergence of opinion” (Helmer & Rand Corporation, 1967). The compiled expert opinions are used to influence practice and/or policy change. This method offers: (a.) anonymity of the experts to freely express opinions and positions (O’Connell & Gardner, 2012), (b.) transformation of opinion into group consensus (De Clercq, Goelen, Danschutter, Vermeulen, & Huyghens, 2011; Melnyk, Gallagher-Ford, Long, & Fineout-Overholt, 2014), and (c.) an accurate assessment of interrater reliability (Chan, Adamson, Chung, & Chow, 2011; Wooden, Docherty, Plaus, Kusek, & Vacchiano, 2014).

A modified Delphi method using an electronic medium for communication between expert panel members and data collection was chosen for our study because it allowed panelists to weigh in on the questions until they reached a consensus.

Methods

Three separate expert panels were assembled and one panel was assigned to each of the stated study aims. This quality improvement study met the criteria for exemption by the Duke University Institutional Review Board and was conducted at the Duke University School of Nursing from July 2016 through January 2017.

Aim 1: Identifying Clinical Activities That Can Be Tested in Simulations

To determine the necessary clinical activities required for reentry to practice, we predominately focused on prior work conducted by the NBCRNA. This included a 2011 Professional Practice Analysis (PPA) study, a search of the associated literature, and recommendations from a select group of nurse anesthetists from around the country who possessed insight into the issues surrounding reentry (i.e., a Reentry Subcommittee). The PPA focused on initial entry into practice; however, it represents global knowledge required of all nurse anesthetists including those seeking reentry into practice (Muckle, Plaus, Henderson & Waters, 2012). The PPA served as the evidential content link between practice and the credentialing examination and served as a foundational component for the development of the NBCRNA’s Reentry Program. The NBCRNA Reentry Subcommittee identified 20 activities deemed to be critical for a reentering nurse anesthetist. This list of activities was the basis of the study, using a modified Delphi method to seek consensus for these clinical activities and potentially identify additional skills beyond those previously identified.

Expert Panel

Because the Delphi method has no strict guidelines on the number of individuals required to participate on an expert panel, and nurse anesthetists make up a small subset of the nursing population, six individuals were asked to participate on the panel. The NBCRNA assisted in panel-member selection because certified nurse anesthetists’ records are privy to that organization. Clinicians were selected based on criteria that aligned with an individual’s familiarity of entry-level knowledge such as working with students in an academic or clinical setting. Desirable credentials, which were inclusion criteria, included current interactions with nurse anesthesia students, a minimum of 5 years of experience as an academic educator, a minimum of 5 years

of practice in a clinical setting, and experience with simulations education. Geographic location, age, and sex were also considered to help create a diverse panel and to accommodate for variations in practice.

Survey Creation

An online tool was selected for data collection. In August 2016, the six panel members were provided the study details and participation was requested via e-mail. All members agreed to the terms, which included participation in all surveys, anonymity, and privacy of results. The surveys were developed by several of the authors based on results from the NBCRNA's PPA. REDCap, a Web-based application for building and managing online databases and surveys, was used for distribution.

Surveying the Experts

The first survey sent to the panelists provided the 20 clinical activities previously identified by the NBCRNA for reentry. Space was also available for panelists to suggest additional activities they felt were necessary for reentry to practice and that could be replicated with high-fidelity simulation. To fully assess the current state of the reentry program requirements, the authors deemed the validation of NBCRNA-identified activities to be an important aspect while concurrently assessing the feasibility of measuring these activities within the simulated environment.

A second survey was administered within 1 week of receiving results from the first survey in September 2016. The second survey listed the activities added by the panel in the first survey as well as the 20 original activities. Panel members were asked to choose if a clinical activity was necessary for reentry to practice and if it could be replicated with high-fidelity simulation by selecting either "yes" or "no." Clinical activities for which at least 70% of the panelists agreed were necessary were included in the final list. Activities with less than or equal to 30% agreement were eliminated from further evaluation.

The third and final survey asked the panel to assess each of the clinical activities that received 30% to 70% consensus on the previous survey by rating their level of agreement regarding the importance of each activity to reentry to practice using the following 4-point Likert-type scale: 1 = strongly agree, 2 = agree, 3 = disagree, and 4 = strongly disagree. The responses were entered into the REDCap database. Activities receiving a mean score of less than 2 were included in the final list, and those activities receiving a mean score of 2 or greater were eliminated. To assess how well each activity was sampled in the measure, we calculated the content validity index (CVI) at the item level, which was set at 0.78 to avoid the risk of chance agreement (Lynn, 1986).

Aim 2: The Use of Simulation for High-Stakes Assessment

Expert Panel

A modified Delphi design was used to seek consensus through a second expert panel to determine if a simulated clinical experience, as opposed to an actual clinical experience, could be used to adequately assess

the ability of a nurse anesthetist to reenter practice. To assess the quality and authenticity of a simulation scenario and operating room environment, a geographically diverse group of nurse anesthetists experienced in areas of anesthesia-based simulation, education, credentialing, and clinical practice were contacted in July 2016. Five CRNAs volunteered to sit on the panel. Inclusion criteria for the panel were: 5 to 15 years of clinical experience with active certification; nurse anesthesia educators with a clinical:education ratio of at least 50:50; nurse anesthetists with more than 2 years of simulation experience with a Certified Healthcare Simulation Educator certification preferred; and a lack of any probationary circumstances or professional misconduct.

Simulation Scenario

After we reviewed the literature to identify a simulation scenario for aims two and three of the study, Kelly & McFarland's (2012) peer-reviewed simulation was chosen. Medline, PUBMED, EMBASE, CINAHL, and the Cochrane Library were used to identify articles of interest. Search terms included nurse anesthetists, competency, competency evaluation, mental competency, educational measurement, patient simulation, and high-fidelity simulation. The chosen literature was evaluated based on the relevance to our study, the year published, the journals from which the literature was published and the peer review process, and a review of each study by the faculty and students of the DNP project committee. The chosen simulation's focus was anaphylaxis during general anesthesia and was designed to assess several entry-level competencies as well as clinical reasoning, management, and motor skills. The scenario depicted anaphylaxis, hypotension, tachycardia, hypoxia, and bronchospasm, all of which are clinical activities for which providers must demonstrate competency for successful completion of the NBCRNA's Reentry Program. This scenario reflected five of the 20 NBCRNA-identified critical tasks for reentry. The remaining tasks were not assessed as part of this study.

Setting

The simulation environment was prepared with the appropriate equipment to facilitate a full intraoperative experience, including supplies and medications to successfully treat anaphylaxis. The goal was to create a realistic operating room environment, affording the reentry participant an optimal setting for suspension of reality and immersion within the experience. In addition, we aimed to showcase the cutting-edge capabilities of simulation, including its ability to portray life-like events while inciting a broad array of genuine human responses from the candidate, such as confidence, composure, anxiety, and relief. A CRNA volunteer was recorded flawlessly managing the case in the simulated operating room environment.

Data Collection

The recorded simulation was distributed in August 2016 to the panelists selected to participate in this step of the study, along with a 15-item questionnaire using REDCap. Questions 1 through 14 of the questionnaire were designed to measure the content validity of the simulation and had response options on a 4-point Likert-type scale (1 = agree, 2 = somewhat agree, 3 = somewhat disagree, 4 = disagree). Question 15 allowed a free-text response and asked panelists to identify any clinical skills or critical actions that they believed

were missing from the CRNA's management of the case scenario. Before distribution, the questionnaire was critiqued by nurse anesthetists, Duke University Nurse Anesthesia Program faculty, and nurse anesthetists staff members of the NBCRNA for content relevance and accuracy. The final set of questions is shown in Table 1. Tabulated results were examined for potential simulation modification and to establish content validity.

Table 1. Simulation Survey Questions and Results

	Question	Agree	Somewhat agree	Somewhat disagree	Disagree
1.	The simulation effectively mirrors an OR environment.	XXXXX			
2.	The simulated OR setting contains the necessary monitors and equipment to recognize and manage an anaphylactic reaction.	XXXX	X		
3.	The simulation accurately reflects the clinical presentation of an anaphylactic reaction as determined by...				
	Vital signs	XXXXX			
	Waveform capnography	XXXX	X		
	Patient condition	XXX	XX		
4.	The simulation allows for a realistic provider response to the anaphylactic reaction.	XXXXX			
5.	The simulation offers the opportunity to demonstrate effective provider communication.	XXXXX			
6.	The simulation effectively demonstrates the provider's management of an anaphylactic reaction.	XXXX		X	
7.	The simulation allows for an accurate assessment of the provider's management of an anaphylactic reaction.	XXXXX			
8.	The simulation allows for a demonstration of the provider's knowledge regarding first-line management of anaphylaxis.	XXXX	X		
9.	The simulation offers situations to assess the provider's technical (e.g., intubation technique) and nontechnical (e.g., cognitive) oriented abilities.	XXXXX			
10.	The simulation allows for a demonstration of the provider's knowledge regarding the goals of treatment for anaphylaxis.	XXXXX			
11.	The simulated scenario describes an anaphylactic situation sufficiently.	XXX	XX		
12.	The simulation's diagnostic cues lead to appropriate actions or interventions by the provider.	XXX	XX		
13.	The simulation, if performed as seen in the video recording, can be effectively used to assess provider management of anaphylactic reactions.	XXXX		X	
14.	The simulation provides an equivalent and/or acceptable substitute to clinical practice for assessing provider competency of rare events such as intraoperative anaphylactic reactions.	XXXXX			

15.	Are there any provider actions absent from the simulated anaphylactic scenario that should be assessed?				
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Note. OR = operating room.

Analysis

To evaluate the content validity of the simulation, a method adapted from Lynn (1986) was used. Each simulation content item on the questionnaire was evaluated for validity using a 4-point ordinal scale. For each item, the CVI was computed by tabulating the number of panelists giving a rating of 1 (agree) or 2 (somewhat agree) divided by the total number of panelists who evaluated the item. For example, for question six, four panelists agreed and one somewhat disagreed. Thus, the content validity for this question was derived by dividing the four “agree” responses by the number of panelists (five); yielding a quotient of 0.8. The overall scale CVI was calculated by deriving the mean of the percentage of items determined relevant across the five panelists. The simulation items were modified until the minimum value of 0.78 per item (the minimum value recommended by Lynn [1986]) was met and deemed to have content validity.

Aim 3: Validating C-CEI and Checklist Simulation-Evaluation Tools

Expert Panel

A modified Delphi design was used to seek consensus of a third expert panel of CRNAs regarding the validity and reliability of the C-CEI and a competency checklist for use in simulation-based high-stakes evaluation of nurse anesthetists seeking reentry to practice. A panel of 12 CRNAs was assembled with assistance from the NBCRNA. Inclusion criteria for the panel included a minimum of 5 years’ clinical experience, previous experience with high-fidelity patient simulation, and a current position as a nurse anesthesia educator. The final sample consisted of an equal distribution of males and females from four demographic locations: Midwest, West, South, and Northeast. Their years of certification ranged from 5 to 18 years with a mean of 12.6 years. All panelists had experience with simulation, were actively involved with the education of nurse anesthesia students, and possessed knowledge of clinical best practices. The group who received the C-CEI completed a brief online educational session provided by the authors regarding tool development, scoring methods, and descriptions of the included behaviors.

Simulation Scenario

Scripted videos were recorded of providers completing the anaphylaxis during general anesthesia simulation scenario (Kelly & McFarland, 2012) at two levels of proficiency: clearly proficient (video 1) and clearly not proficient (video 2). The actor in video 1 was asked to appropriately address all behaviors in the C-CEI and the competency checklist, whereas the actor in video 2 was asked to leave out key behaviors from the C-CEI and the competency checklist.

Competency Checklist

The competency checklist was based on the learning outcomes and actions presented in the anaphylaxis during general anesthesia simulation scenario (Kelly & McFarland, 2012). The original checklist contained 46 behaviors and was distributed to the Duke University School of Nursing Nurse Anesthesia Program faculty who are actively recertified nurse anesthetists and maintain a clinical practice. After faculty feedback, the final checklist included 38 behaviors deemed necessary to delivery anesthesia care (Table 2). The checklist allows the panelist to choose that a behavior was completed or not completed and also provides a place for comments on each behavior. The overall score is determined by dividing the number of completed behaviors by the total number of behaviors in the checklist.

Table 2. Anesthesia Care Behaviors Checklist for Panelists

Step	Task	Completed	Not Completed	Comments:
Baseline:				
1	Attach routine monitoring equipment and obtain baseline vital signs (pulse oximetry, NIBP, EKG, PNS, temperature)			
2	Place mask and begin preoxygenating patient			
3	Reassess patient's fitness for anesthesia based on preinduction VS and $ETO_2 > 80$			
4	Verify suction is on and within reach			
Induction:				
5	Administer induction agent of choice			
6	Determine patient unresponsiveness (loss of lash reflex, apnea)			
7	Verify ability to ventilate patient			
8	Check baseline TOF with PNS			
9	Administer muscle relaxant			
10	Tape patients' eyes			
11	Intubate and determine correct ETT placement			
12	Turn on volatile agent			
13	Adjust fresh gas flows			
14	Turn on ventilator with appropriate settings			
15	Secure ETT			
16	Verify antibiotic order and administration			
17	Add additional monitors when appropriate (Bair Hugger, temperature probe, etc.)			
18	Complete surgical timeout			
19	Properly secure drapes when prompted			
Anaphylactic Reaction begins				
20	Recognize alteration in vital signs, peak airway pressures			
21	Assess ETT and circuit for mechanical issues (kinks, etc)			

22	Auscultate bilateral lung fields			
23	Administer β_2 agonist to treat developing bronchospasm (increased peak pressures)			
24	Increase fluid administration			
25	Administer phenylephrine in 100 mcg increments			
26	Discuss differential diagnosis			
Severe Anaphylaxis				
27	Stop all medications/blood products, etc.			
28	Request immediate assistance/informs the surgeon			
29	Change position to Trendelenburg to assist with hypotension			
30	Administer 100% FiO ₂			
31	Administer 10 mcg of epinephrine			
32	Delegate to member of OR team to initiate large bore IV			
33	Administer IVF at maximum rate			
34	Repeat epinephrine with increasing doses			
35	Verbalize consideration of arterial line placement			
36	Verbalize consideration of administering other medications to assist with treatment of anaphylaxis -Corticosteroids, diphenhydramine, ranitidine, other vasoactive medications			
Conclusion				
37	Initiate epinephrine infusion to maintain patient's vital signs			
38	Verbalizes planned disposition for this patient for immediate postoperative period			

Note. EKG = electrocardiogram; ETO₂ = end tidal oxygen concentration; ETT = endotracheal tube; FiO₂ = fraction of inspired oxygen; IV = intravenous; IVF = intravenous fluid; NIBP = noninvasive blood pressure; PNS = peripheral nervous system; OR = operating room; TOF = train of four.

Validity

The 12 panelists were randomly assigned to three groups of four and were asked to complete a survey that evaluated the C-CEI (group 1), the competency checklist (group 2), or both the C-CEI and the competency checklist (group 3). The survey used a 4-point Likert-type scale from 1 (strongly disagree) to 4 (strongly agree) to rate the instrument on the following: the content of the tool was clear, the tool was easy to use, and the use of the tool was appropriate for rating a nurse anesthetist's performance in this scenario. Data were collected from the REDCap survey and the completed evaluation tools and analyzed via IBM SPSS version 23 software.

Reliability

To evaluate interrater reliability of the C-CEI and the competency checklist tools, the panelists in groups 1 and 2 were asked to view video 1 and video 2 depicting management of anaphylaxis during general anesthesia

and use either the C-CEI or the competency checklist to score each provider. The panelists in group 3 were asked to view each video twice and score the providers using both the C-CEI and the competency checklist. Panelists were blinded to the providers' intended level of proficiency in each video.

Provider Proficiency

The final component of the survey asked the panelists to rate the general proficiency of the provider in each of the two videos on a 3-point Likert scale: 1 = clearly not proficient, 2 = borderline, or 3 = clearly proficient. Panelists were provided with conceptual definitions of clearly not proficient, borderline, and clearly proficient provider as a guide.

Analysis

To examine the content validity of the C-CEI and the competency checklist, the Lynn method was used (Lynn, 1986). To calculate the item CVI, the number of panelists rating an item as 3 (agree) or 4 (strongly agree) were added and divided by the total number of panelists. Subsequently, an overall CVI was calculated by summing the item CVIs and dividing by the number of items evaluated. To evaluate interrater reliability, the C-CEI and competency checklist scores were analyzed separately. The intraclass correlation coefficient was used to assess agreement between panelists scores of video 1 and video 2, for both the C-CEI and the competency checklist. Finally, Spearman correlation was used to examine the association between the C-CEI and checklist scores within each video.

Results

Aim 1: Identifying Clinical Activities That Can Be Tested in Simulations

Results from the first expert-panel survey identified an additional 14 clinical activities beyond the original 20. Of the 34 clinical activities evaluated during the second survey, a total of 14 gained consensus for necessity and feasibility of being tested via simulation, three clinical activities were eliminated and 17 required further assessment through the third survey. Third survey results identified 13 clinical activities that received consensus and validation by the expert panel, and they eliminated four activities. After combining the results from all three surveys, 27 clinical activities were identified by the panelists as necessary for CRNAs attempting reentry and feasible to reproduce with high-fidelity simulation (Table 3).

Table 3. Activities Required for Reentry to Practice

Final list of clinical activities identified by the expert panel:

- Bronchospasm
- Difficult intubation
- Unstable arrhythmia
- Malignant hyperthermia
- Anaphylaxis/allergy
- Rapid sequence induction
- Laryngospasm
- Desaturation
- Hemorrhagic shock

- Myocardial infarction
- High spinal
- Anesthesia machine malfunction
- Cardiac arrest
- Airway fire
- Aspiration
- Knowledge of pharmacology
- Transfusion reaction
- Local anesthetic toxicity
- Anesthesia pre-evaluation
- Oxygen pipeline failure
- Pulmonary embolism
- OR power failure
- Obstructed endotracheal tube
- Massive transfusion
- Hyper/hypotension
- Unanticipated extubation
- Treatment of bradycardia & tachycardia

Note. OR = operating room.

Aim 2: The Use of Simulation for High-Stakes Assessment

All five panelists responded to the survey questions regarding simulations utility in high-stakes assessment. The majority of survey responses were either “agree” or “somewhat agree,” and each question exceeded the minimum CVI of 0.78. One panelist graded questions 6 and 13 (Table 1) as somewhat disagree. The overall scale CVI was .99 and was derived from the mean of the percentage of items determined relevant across the five expert panelists. Because the content validity was achieved during the first round of data collection, no subsequent modifications were made to the simulation. Free-text comments provided by the expert panel (Table 4) offered guidance regarding the importance of assessing independent practice, the selection and timing of medication administration, the potential use of cognitive/emergency aids, and the importance of personal protective equipment. Some panelists felt their inability to clearly see the ventilator settings and peak airway pressures on the recorded simulation video may have decreased their ability to provide accurate feedback in this area. Only comments directly addressing the realism or accuracy of the simulated environment were included in the Table. Although comments were also received that encouraged evaluation of CRNA independent practice, they were not included as they were outside the scope of this project.

Table 4. Free Text Responses (Aim 2)

<p>Question 1: The simulation effectively mirrors an OR environment.</p> <ul style="list-style-type: none"> • The environment was so good the little things stood out (the tech applying the drapes upside down). • Except CRNA did not wear gloves • The physical environment in this simulation is excellent. The machine and monitors, OR table, prepping and draping of the patient are very realistic. The actors in various roles are excellent as well. • The anesthetist should have been wearing gloves but overall it was a good depiction.
<p>Question 2: The simulated OR setting contains the necessary monitors and equipment to recognize and manage an anaphylactic reaction.</p>

- I did not see any anesthesia cognitive aid or emergency manual. The Anesthesia Patient Safety Foundation has called for their use and the evidence shows that during low-frequency high-risk critical events anesthesia providers are unable to recall all the correct treatment options. Here's a couple of links: <http://emergencymanual.stanford.edu/> <http://www.emergencymanuals.org/index.html>. A couple of things from the checklist that I noticed is that while the patient was unstable the volatile agent was still on and the provider chose dexamethasone instead of hydrocortisone. Also she was very clear on her epinephrine and neosynephrine doses but just stated 'benadryl, zantac, and dexamethasone' with no doses given.

Question 3: The simulation accurately reflects the clinical presentation of an anaphylactic reaction as determined by...(vital signs, waveform capnography, patient condition)

- As with all simulations there are some limitations to what you can achieve. It's good that she looked at the chest but how did she know there was rash on the patient's chest? I did not see one and I did not hear any audio clue that the patient had a rash.
- Prior to recognition, vent was alarming and although I could not see values clearly, probably elevated PIP, which could point CRNA to auscultation earlier.
- It would be helpful to see an increase in airway pressures on the ventilator.

Question 4: The simulation allows for a realistic provider response to the anaphylactic reaction.

- No free-text responses given.

Question 5: The simulation offers the opportunity to demonstrate effective provider communication.

- No free-text responses pertinent to project.

Question 6: The simulation effectively demonstrates the provider's management of an anaphylactic reaction.

- The benadryl and decadron are given very late in the scenario. The albuterol is given and then the provider waits for the anesthesiologist to show up. She should be treating the patient with benadryl and decadron right away. These drugs are given after the MDA is present and starting an arterial line and 2nd PIV and after an epi infusion is started. The provider does not note an increase in airway pressures.

Question 7: The simulation allows for an accurate assessment of the provider's management of an anaphylactic reaction.

- No free-text responses given.

Question 8: The simulation allows for a demonstration of the provider's knowledge regarding first line management of anaphylaxis.

- Again, the benadryl and decadron are given very late in the scenario. The albuterol is given and then the provider waits for the anesthesiologist to show up. She should be treating the patient with benadryl and decadron right away. The provider does not note an increase in airway pressures.

Question 9: The simulation offers situations to assess the provider's technical (e.g., intubation technique) and nontechnical (e.g., cognitive) oriented abilities.

- No free-text responses given.

Question 10: The simulation allows for a demonstration of the provider's knowledge regarding the goals of treatment for anaphylaxis.

- The simulation will allow for it.

Question 11: The simulated scenario describes an anaphylactic situation sufficiently.

- See previous comments.

Question 12: The simulation's diagnostic cues lead to appropriate actions or interventions by the provider.

- Again as stated above, high PIP alarm could prompt auscultation to assess why getting PIP alarm.

Question 13: The simulation, if performed as seen in the video recording, can be effectively used to assess provider management of anaphylactic reactions.

- See previous comments.

Question 14: The simulation provides an equivalent and/or acceptable substitute to clinical practice for assessing provider competency of rare events such as intraoperative anaphylactic reactions.
<ul style="list-style-type: none"> Simulation is an excellent venue to allow for a controlled environment for learning. It promotes team steps and collaboration.
Question 15: Are there any provider actions absent from the simulated anaphylactic scenario that should be assessed?
<ul style="list-style-type: none"> Use of a cognitive aid as previously mentioned. Evaluate Vent alarm, which I believe alarmed 2-3 times prior to ETCO₂ rise. The benadryl and decadron are given very late in the scenario. The albuterol is given and then the provider waits for the anesthesiologist to show up. She should be treating the patient with benadryl and decadron right away. The provider does not note an increase in airway pressures. Not readily apparent.

Note. CRNA = registered nurse anesthetist; ETCO₂ = end tidal oxygen concentration; PIP = peak inspiratory pressure; PIV = peripheral intravenous catheter; MDA = physician anesthesiologist.

Aim 3: Validating C-CEI and Checklist Simulation-Evaluation Tools

Study materials and completed evaluation tools were not received from two of the 12 panelists, both of whom were in the C-CEI group (group 1). Therefore, the results are based on a sample of 10 panelists. Six panelists evaluated the C-CEI (two panelists from group 1 and four from group 3) and eight evaluated the checklist (four panelists from group 2 and four from group 3).

Validity

All six panelists that evaluated the C-CEI agreed that the content of the tool was clear. Five agreed that it was easy to use, but only four agreed that use of the C-CEI was appropriate for rating a nurse anesthetist's performance in the scenario. The overall CVI for the C-CEI was 0.83 (Table 5). Of the eight panelists who evaluated the competency checklist, all agreed that content of the tool was clear, easy to use, and was appropriate for rating a nurse anesthetist's performance in the scenario. The overall CVI for the competency checklist was 1.0 (Table 6).

Table 5. Content Validity for C-CEI

Item	Rater						Number in Agreement	Item CVI
	1	2	3	4	5	6		
Content is clear	x	x	x	x	x	x	6	1.0
Easy to use	x	x	x	x		x	5	.83
Appropriate	x	x	x	x			4	.67
								Mean CVI: .83

Note. C-CEI = Creighton Competency Evaluation Instrument; CVI = content validity index.

Table 6. Content Validity for Checklist

Item	Rater								Number in Agreement	Item CVI
	1	2	3	4	5	6	7	8		
Content is clear	x	x	x	x	x	x	x	x	8	1.0
Easy to use	x	x	x	x	x	x	x	x	8	1.0
Appropriate	x	x	x	x	x	x	x	x	8	1.0
										Mean CVI: 1.0

Note. C-CVI = content validity index.

Reliability

As anticipated, panelists’ mean scores on both the C-CEI and the checklist were higher for the provider in video 1 (i.e., the “proficient” provider) compared with scores for the provider in video 2 (i.e., the “not proficient” provider). The six C-CEI scores for the provider in video 1 varied from 83.3-94.4 with a mean score of 89.8, and the eight checklist scores varied from 81.5 to 97.7 with a mean score of 90.3. The six C-CEI scores of the provider in video 2 varied from 72.2 to 100 with a mean score of 83.9, and the eight checklist scores varied from 60.5 to 84 with a mean score of 74.6.

Agreement between panelists’ scores of video 1 and video 2 using the C-CEI was found to be “fair” (Cicchetti, 1994), with a mean intraclass correlation coefficient of 0.50. Two of the six panelists scored video 1 lower than video 2, despite the fact that video 1 was meant to represent the proficient provider (Figure 1). When panelists’ checklist scores of video 1 and video 2 were analyzed, agreement was found to be “excellent” (Cicchetti, 1994), with an average measures intraclass correlation coefficient of 0.98. All panelists using the checklist scored video 1 higher than video 2 (Figure 2). There was no correlation between C-CEI and checklist scores for video 1 or video 2 (Spearman rho (2) = 0.20, $p = .80$; Spearman rho (2) = - 0.40, $p = .60$).

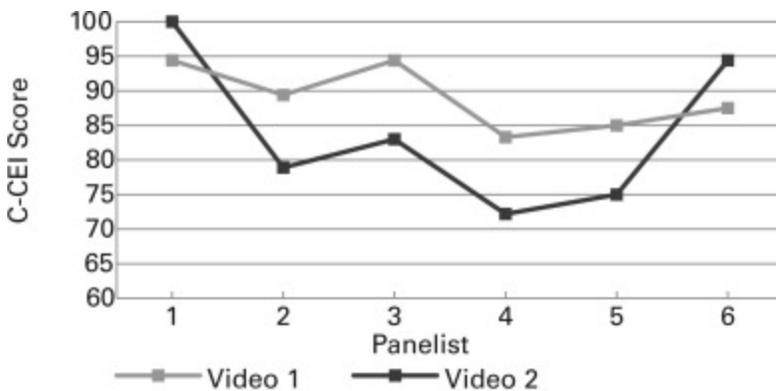


Figure 1. Panelist C-CEI Scores for the Providers in Video 1 and Video 2

Note. The provider in video 1 was depicting a “proficient” provider, whereas the provider in video 2 was depicting a “not proficient” provider. C-CEI = Creighton Competency Evaluation Instrument.

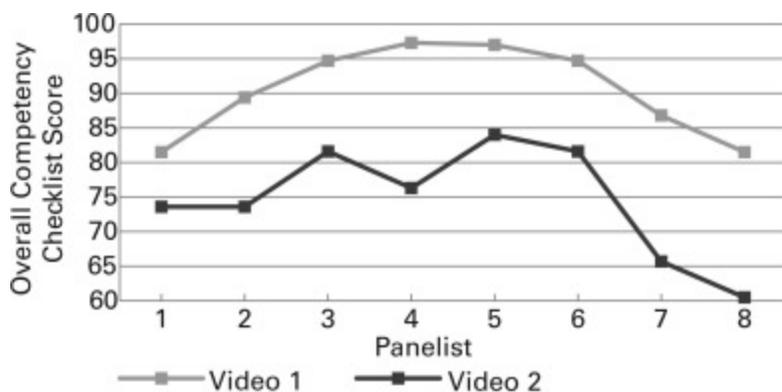


Figure 2. Panelist Competency Checklist Scores for the Providers in Video 1 and Video 2

Note. The provider in video 1 was depicting a “proficient” provider, whereas the provider in video 2 was depicting a “not proficient” provider.

Discussion

Although the use of high-fidelity simulation is applauded for its important role in medical education, provider training, and skills assessment, knowledge gaps exist regarding its ability to serve as a high-stakes assessment tool for certification or reentry purposes.

Aim 1: Identifying Clinical Activities That Can Be Tested in Simulations

With varying degrees of skill and comprehension in nursing practice, a consensus of collective knowledge has been the predominant method in identifying and verifying clinical competencies. Findings from this quality improvement study are consistent with current literature, suggesting that surveying specialty nurses at the national level could be an effective method in obtaining practice consensus.

Because the majority of the NBCRNA-identified clinical activities received consensus by the expert panel, it could be inferred that the final list of activities (Table 3) are appropriate for reentry to practice for nurse anesthetists.

Aim 2: The Use of Simulation for High-Stakes Assessment

The data collected from CRNA panelists suggests that high fidelity simulation provides an effective alternative to actual operating room experiences for assessing a reentering nurse anesthetist’s management of an anaphylactic reaction. In addition, a reentry candidate is unlikely to experience and/or manage a true anaphylactic emergency during the reentry process or subsequent clinical practice, so this method of assessment allows the opportunity to assess the provider’s competence in response to a critical intraoperative event. This three-step study can also guide the future validation of other simulation scenarios containing critical reentry activities for assessing reentry candidates.

The use of simulation for performance assessment purposes is increasingly common across multiple disciplines and offers a viable tool for nurse anesthetists when seeking reentry to practice. For example, the American Heart Association currently uses simulated experiences for nurse anesthetists, as well as other health care workers, in the high-stakes certification process for Advanced Cardiac Life Support, Basic Life Support,

and Pediatric Advanced Life Support (American Heart Association, 2017). Additionally, high-fidelity simulation has been found to provide an effective means to evaluate competency and retrain anesthesiologists seeking reentry to practice (DeMaria, Samuelson, Schwartz, Sim, & Levine, 2013). The panel's unanimous agreement on question 14, noting the simulation's ability to provide an acceptable substitute to clinical practice for assessing provider competency, certainly favors the use of high-fidelity patient simulation for high-stakes assessment.

Aim 3: Validating C-CEI and Checklist Simulation-Evaluation Tools

Results of the panelists' evaluation of the C-CEI and competency checklist provided significant insight regarding the validity and reliability of each evaluation tool. According to Lynn's (1986) criteria, both the C-CEI and the checklist met the recommended CVI of 0.78 and can be judged as having excellent content validity. However, through our testing of each evaluation method, we found that the checklist was a better tool for assessing provider competency. Interrater reliability was also found to be higher for the competency checklist than the C-CEI. Overall analysis of the C-CEI and competency checklist indicate that use of the competency checklist may provide a more valid and reliable means of evaluating nurse anesthetists in high-stakes simulation scenarios for the purposes of reentry to practice.

Limitations

Although the findings of this study support the intended objective, limitations must also be considered. A limitation of all three steps was the small sample of expert CRNAs and the potential introduction of bias due to the use of NCBRNA-identified panelists. Although the Delphi method has no strict guidelines on the number of individuals required to participate on the expert panel, a larger number of expert opinions may have produced a broader perspective on each of the aims of the study and added value and impact to the outcomes. To minimize the introduction of bias, individuals identified by the NCBRNA to participate on these expert panels were distinct from the groups previously selected for the 2011 PPA and the Reentry Subcommittee.

Limitations specific to the first aim of the study include a lack of diversity in practice environment among the panelists. The six panel members selected to participate in this step all practice and interact in an academic setting where an anesthesia care team is the predominant model. Practice parameters between academic and rural facilities may vary, which would negate the need for some of the activities described in the surveys. Additionally, various clinical activities including vascular access, treatment of pulmonary edema, and regional anesthesia were eliminated by the panel yet were identified as being necessary by the NCBRNA. Several factors, such as the thought that activities could not be replicated with high-fidelity simulation or the phrasing of the questions to indicate that simulation was the only method to replicate the activities, could have contributed to activity exclusion. It is possible that a panel member thought a clinical activity was necessary for reentry-level practice but decided it would not be feasible to replicate with the use of simulation. Allowing panel members to provide rationale for the inclusion or exclusion of an activity is a potential solution to this limitation. Panelists' experience with high-fidelity simulation may have influenced the results of the second aim. Three of the panelists had experience with high-fidelity simulation and may have offered a more positive, subjective

opinion. However, two providers inexperienced in simulation training were also included to decrease panel bias, potentially offering greater objectivity.

A common theme among panel responses for the second and third aims was the inability to view ventilator settings and changes in peak airway pressures during the simulation video. Panelists commented on the REDCap survey that this diminished their ability to accurately assess the provider and the environment. The very nature of simulation also contains inherent weaknesses. Some patient conditions are impossible to realistically replicate in a simulated environment, and provider training/assessment must occur through different avenues.

Finally, use of the Delphi method to develop the competency checklist may have improved its validity and reliability for use in simulation-based high-stakes evaluation of nurse anesthetists seeking reentry to practice. One panelist's comment alluded to the granularity of the competency checklist and suggested that expert opinion regarding critical components of anaphylaxis management should be evaluated and included in the tool.

Conclusion

Simulation-based training and assessment provides many health care professions with the means to teach foundational principles, enhance motor and cognitive skills, and evaluate provider competency. The exchange of simulated experiences in place of direct patient care experiences for the nurse anesthetist seeking to reenter practice may allow for a greater overall success of the reentry process. These studies are the first steps towards validating the appropriateness of simulation in exchange for direct patient care. Further study and evaluation is necessary to establish a demonstrable link between simulation and successful reentry to practice. Additional evaluation is also necessary to assess whether simulation is an appropriate method of assessment for all 27 clinical activities identified by the expert panel. The NBCRNA's Reentry Program was designed to incorporate the innovation and technology advancements associated with simulation to facilitate a practical reentry process for nurse anesthetists. Additionally, eliminating a major barrier to reentry to practice through use of a simulated patient care experience has the potential to increase the current anesthesiaworkforce, which has been projected to be in short supply through the year 2020 (RAND, 2010).

The goal of this study was to identify a set of clinical activities that could be applied to and evaluated within a simulated patient care scenario and that could be adopted by the NBCRNA to standardize this new element of reentry to practice. The findings of this study add to the existing literature supporting the use of simulation for high-stakes provider assessment and the use of simulation within certification programs. The framework and methodology developed and evaluated in this study could serve as a guide to validate and standardize the process for the remaining clinical activities and simulation scenarios deemed necessary for reentry to practice. The results of this study may also be of interest to state boards of nursing as these

regulatory boards consider avenues for reentry to practice for advanced practice nurses as well as registered nurses.

References

- American Heart Association, 2017. American Heart Association. HeartCode ACLS (2017). Retrieved from: http://cpr.heart.org/AHA/ECC/CPRECC/Training/HealthcareProfessional/AdvancedCardiovascularLifeSupportACLS/UCM_476132_HeartCode-ACLS.jsp
- Chan et al., 2011. Chan W., Adamson B., Chung J., Chow M. **Validity and reliability of the proposed core competency for infection control nurses of hospitals in Hong Kong.** *American Journal of Infection Control*, 39 (3) (2011)
- Cicchetti, 1994. Cicchetti D.V. **Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology.** *Psychological Assessment*, 4 (1994), pp. 284-290, 10.1037/1040-3590.6.4.284
- De Clercq et al., 2011. De Clercq G., Goelen G., Danschutter D., Vermeulen J., Huyghens L. **Development of a nursing practice based competency model for the Flemish master of nursing and obstetrics degree.** *Nurse Education Today*, 31 (1) (2011), pp. 48-53
- DeMaria et al., 2013. DeMaria S., Samuelson S., Schwartz A., Sim A., Levine A. **Simulation-based assessment and retraining for the anesthesiologist seeking reentry to clinical practice.** *Anesthesiology*, 119 (1) (2013), pp. 206-217
- Hayden et al., 2014. Hayden J., Keegan M., Kardong-Edgren S., Smiley R.A. **Reliability and validity testing of the Creighton Competency Evaluation Instrument for use in the NCSBN National Simulation Study.** *Nursing Education Perspectives*, 35 (4) (2014), pp. 244-252
- Hayden et al., 2014. Hayden J.K., Smiley R.A., Alexander M., Kardong-Edgren S., Jeffries P.R. **The NCSBN national simulation study: A longitudinal, randomized, controlled study replacing clinical hours with simulation in prelicensure nursing education.** *Journal of Nursing Regulation*, 5 (2014), p. 2
- Helmer and Corporation, 1967. Helmer O., Rand Corporation. **Analysis of the future: The Delphi method.** Rand Corporation, Santa Monica, CA (1967)
- Ilgen et al., 2015. Ilgen J.S., Ma I.W.Y., Hatala R., Cook D.A. **A systematic review of validity evidence for checklists versus global rating scales in simulation-based assessment.** *Medical Education*, 49 (2) (2015), pp. 161-173
- Institute of Medicine, 2011. Institute of Medicine. **The future of nursing: Leading change, advancing health.** National Academies Press, Washington, DC (2011)
- Kelly et al., 2012. Kelly E., McFarland D., Central Simulation Committee. **Anaphylaxis during general anesthesia.** *Simulation in Healthcare: Journal of the Society for Simulation in Healthcare*, 7 (4)(2012), pp. 261-266
- Krage and Erwtteman, 2015. Krage R., Erwtteman M. **State-of-the-art usage of simulation in anesthesia: Skills and teamwork.** *Current Opinion in Anaesthesiology*, 28 (6) (2015), pp. 727-734, 10.1097/aco.0000000000000257
- Lioce et al., 2013. Lioce L., Reed C.C., Lemon D., King M.A., Martinez P.A., Franklin A.E., Boese T., ..., Borum J.C. **Standards of best practice: Simulation standard III: Participant objectives.** *Clinical Simulation in Nursing: Supplement*, 9 (June 01, 2013), p. 6

- Lynn, 1986. Lynn M.R. **Determination and quantification of content validity.** *Nursing Research*, 35 (6) (1986), pp. 382-385
- Melnyk et al., 2014. Melnyk B., Gallagher-Ford L., Long L., Fineout-Overholt E. **The establishment of evidence-based practice competencies for practicing registered nurses and advanced practice nurses in real-world clinical settings: Proficiencies to improve healthcare quality, reliability, patient outcomes, and costs.** *Worldviews on Evidence-Based Nursing*, 11 (1) (2014), pp. 5-15
- Muckle T., Plaus K., Henderson J., Waters E. **Professional practice analysis: Determining job relatedness of the certification examination for nurse anesthetists.** *Journal of Nursing Regulation*, 3 (3) (2012), pp. 55-61
- National Board of Certification and Recertification for Nurse Anesthetists, 2015. National Board of Certification and Recertification for Nurse Anesthetists. *Refresher program handbook* (2015): Retrieved from: http://www.nbcna.com/recertification/Documents/Refresher_June_2015.pdf
- National Board of Certification and Recertification for Nurse Anesthetists, 2017. National Board of Certification and Recertification for Nurse Anesthetists. **Reentry/refresher. program.** (2017). Retrieved from: <http://nbcna.com/CPC-Recert/Pages/Reentry-Refresher-Program.aspx>
- O'Connell and Gardner, 2012. O'Connell J., Gardner G. **Development of clinical competencies for emergency nurse practitioners: A pilot study.** *Australasian Emergency Nursing Journal*, 15 (4) (2012), pp. 195-201
- RAND Corporation, 2016. RAND Corporation. **Delphi method.** (2016). Retrieved from: <http://www.rand.org/topics/delphi-method.html>
- Steadman and Huang, 2012. Steadman R.H., Huang Y.M. **Simulation for quality assurance in training, credentialing and maintenance of certification.** *Best Practice and Research in Clinical Anesthesiology*, 26 (1) (2012), pp. 3-15, 10.1016/j.bpa.2012.01.002
- Turner et al., 2014. Turner K., Bell M., Bays L., Lau C., Lai C., Kendzerska T., Evans C., Davies R. **Correlation between global rating scale and specific checklist scores for professional behaviour of physical therapy students in practical examinations.** *Education Research International*, 2014 (7) (2014), pp. 1-6
- Wooden S., Docherty S., Plaus K., Kusek A., Vacchiano C. **Exploration of specialty certification for nurse anesthetists: Nonsurgical pain management as a test case.** *Pain Management Nursing*, 15 (4) (2014), pp. 789-797