

Professional Practice Analysis: Determining Job Relatedness of the Certification Examination for Nurse Anesthetists

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This article presents the results of the 2011 professional practice analysis (PPA) for the field of nurse anesthesia conducted by the National Board of Certification and Recertification for Nurse Anesthetists. The PPA used survey and rating scale methodologies to collect data regarding the relative emphasis on various aspects of the nurse anesthesia knowledge domain and competencies. Overall, 9,000 survey responses were analyzed by a panel consisting of individuals possessing expertise in clinical anesthesia and testing methodology, using conventional statistics and the Rasch rating scale model. Descriptions of how the survey results were used to develop test specifications are also provided. The results of this analysis provide validity evidence for the content outline and test specifications (content percentages) and thus serve as a basis of content validation for the National Certification Examination.

Through its certification process, the National Board of Certification and Recertification for Nurse Anesthetists (NBCRNA) seeks to maintain a high level of knowledge, skill, and professionalism among certified registered nurse anesthetists (CRNAs) and to foster high-quality anesthesia care for patients. The NBCRNA is charged with protecting and serving the public by ensuring that individuals credentialed as CRNAs have met predetermined qualifications or standards for providing nurse anesthesia services (National Board of Certification and Recertification for Nurse Anesthetists, 2012). In partial fulfillment of this mission, the NBCRNA develops, maintains, and administers a certification examination that assesses whether nurse anesthesia practitioners have attained competencies necessary for safe and effective entry-level practice in the United States. One key feature of examination development is content validation, a process that helps ensure test content and specifications are formulated on the basis of current clinical practice.

The purpose of regulation through certification and licensure is to provide assurance to the public that individuals working in a particular profession or job role possess the requisite knowledge to practice safely and responsibly. Consistent with this purpose, credentialing examinations for certification must be demonstrated to be job related (Raymond & Neustel, 2006). To this end, professional practice analysis (PPA) methodologies have played and continue to play a considerable role in examination content validation, especially in nursing and nursing specialties (Kane, Kingsbury, Colton, & Estes, 1986).

Administration of a PPA usually involves the development of a survey in which the items reflect various aspects, concepts, topics, techniques, and procedures commonly encountered in the profession. Survey respondents are typically asked to indicate the importance, frequency, or criticality of each survey element, using a rating scale. According to national testing standards, credentialing agencies should repeat their validation studies on a periodic basis commensurate with the degree of change in the profession (American Educational Research Association, 1999; National Commission for Certifying Agencies, 2004). The NBCRNA has previously performed content validation studies in 1996 (Zaglaniczny & Healey, 1998), 2001 (McShane & Fagerlund, 2004), and 2007 (Muckle, Apatov, & Plaus, 2009).

In 2011, the NBCRNA conducted another PPA study to serve as the foundation of content validity for its credentialing examination, the National Certification Examination (NCE). The purposes of the PPA were to determine the knowledge and skill that newly certified nurse anesthetists must have to provide competent care and to serve as the evidential link between the practice of nurse anesthesia and the credentialing examination. The PPA focused on relevant elements of responsibility in the specialty and identified the knowledge base that nurse anesthetists use in the early stages of their careers.

This article describes the 2011 PPA, including summaries of the survey methodology used to validate the domains and subdomains of the NCE content outline, the survey results, and the subsequent decisions made by the NBCRNA regarding revisions to the NCE test blueprint.

Survey Design and Distribution

The practice analysis process began with a comprehensive review of the NCE content outline by the practice analysis panel, composed of four nurse anesthetists, chosen on the basis of sex, ethnicity, geographic region, clinical setting, and educator/practitioner status. The practice analysis panel conducted a gap analysis of the current NCE content outline, which resulted in several minor revisions to the knowledge statements in the content outline. The revisions clarified existing statements and included new statements addressing recent changes in anesthesia practice for possible validation. The modified content outline was then converted to a survey format.

The survey phase of the study was important because CRNAs should have input into the definition of their practice. Evaluation by the eligible community is essential to make generalizations about the domains, subdomains, and knowledge statements to the practice of nurse anesthetists.

Castle Worldwide, the testing vendor NBCRNA used for the validation study components of the practice analysis, developed the survey based on the content outline as developed by the practice analysis panel to collect assessments from CRNAs about the relevance and importance of the domains (basic sciences; equipment, instrumentation, and technology; basic principles of anesthesia; advanced principles of anesthesia; and professional issues) and subdomains noted in Tables 1 and 2.

Three Scales

The primary survey was designed for delivery online. Three scales were employed for these important evaluations: performance expectation, criticality, and frequency. Participants were asked to rate each domain and subdomain using these scales: The questionnaire also solicited demographic information from respondents to ensure that a representative response from practicing nurse anesthetists was obtained.

Performance Expectation

At what point in the career is the newly certified nurse anesthetist first expected to perform duties that require proficiency in the domain or topic?

- 0 = Not at all
- 1 = Within the first 6 months of certification (includes exactly 6 months)
- 2 = After the first 6 months of certification (does not include exactly 6 months)

Criticality

To what degree would the inability of newly certified nurse anesthetists to perform duties that require proficiency in the domain or topic be seen as causing harm to patients and other stakeholders? (Harm may be seen as physical, psychological, emotional, legal, financial, etc.)

- 0 = No harm

- 1 = Minimal harm
- 2 = Moderate harm
- 3 = Substantial harm
- 4 = Extreme harm

Frequency

Frequency refers to how often newly certified nurse anesthetists perform duties that require proficiency in the domain or topic.

- 0 = Not at all
- 1 = One time per year
- 2 = One time per month
- 3 = One time per week
- 4 = One or more times per day

Respondent Sample

NBCRNA surveyed all 36,123 active nurse anesthetists. The survey sample consisted of the population of CRNAs whose e-mail address was in the NBCRNA database. Castle Worldwide sent an e-mail, containing a URL link to the online survey, inviting all CRNAs to participate in the study. Castle also monitored responses and sent four e-mail reminder notices to three categories of the sample: those who had not opened the survey at all, those who had started but not completed the survey, and those who had finished it. Data collection took place from August 8 through September 12, 2011.

Of the eligible population, 11,151 individuals provided data to some degree; however, a large number provided data that were insufficient or irregular. Castle and NBCRNA determined that to be included in the analysis, the answer record had to meet the following conditions: no less than 30% of the 81 response opportunities for domains and subdomains had to have ratings, and there had to be at least one non-zero rating for domains and subdomains. Using this strategy resulted in 9,003 qualified, usable responses. The response rate (24.9%) is satisfactory for a PPA survey. However, not all individuals responded to every question, so the total number of responses per question varies.

Data were collected on key demographic variables, including sex, ethnicity, age, practice setting, clinical responsibility, educational background, and geographic region. When analyzed, the demographic data were consistent with previous NBCRNA studies and with demographic analyses conducted by the American Association of Nurse Anesthetists (AANA). The response was generally representative of the CRNA profession and provides a robust basis for validation decision making.

Validation of Practice for the Newly Certified Nurse Anesthetist

Respondents were asked to evaluate each domain and subdomain, using the scales for performance expectation, criticality, and frequency.

TABLE 1

Performance Expectation Percentages for Domains and Subdomains

	Not At All	Within First 6 Months	After First 6 Months
Basic Sciences	1.7	92.1	6.2
Anatomy, physiology, and pathophysiology	1.2%	92.1%	6.7%
Pharmacology	1.3	92.3	6.5
Applied chemistry, biochemistry, physics	9.9	78.2	11.9
Equipment, Instrumentation, and Technology	1.7	92.3	6.0
Anesthetic delivery systems	1.5	92.6	6.0
Airway equipment	1.1	92.8	6.1
Monitoring devices	1.7	92.7	5.6
Basic Principles of Anesthesia	1.5	91.7	6.8
Preoperative assessment and preparation of patient	1.4	90.7	8.0
Fluid/blood replacement	1.4	92.0	6.6
Positioning (technique, physiologic alterations, complications)	1.6	91.6	6.8
Interpretation of data	1.8	88.8	9.3
Airway management, including difficult airway	1.0	88.4	10.6
Local/regional anesthesia	3.9	73.1	22.9
Monitored anesthesia care/conscious sedation	0.8	95.2	4.0
Postoperative pain management	8.1	71.0	21.0
Other techniques	6.9	71.3	21.8
Postanesthesia care/respiratory therapy	7.7	77.5	14.7
Advanced Principles of Anesthesia	1.7	79.1	19.2
Surgical procedures and procedures related to organ systems	1.9	80.6	17.5
Pediatrics	4.2	75.3	20.5
Obstetrics	7.2	73.5	19.3
Geriatrics	2.1	88.1	9.8
Obesity	1.6	87.9	10.5
Chronic pain management	25.3	34.6	40.1
Professional Issues	5.7	63.3	30.9
Legal	8.7	60.6	30.7
Research and quality improvement	17.4	36.9	45.7
Professional practice standards	4.8	77.4	17.8
Patient safety	1.9	92.1	6.0

Domains

The prevalence of opinion is most appropriately assessed as the percentage of respondents indicating a 0, 1, or 2. Of primary interest in the performance expectation scale is whether respondents indicate that newly certified individuals must be proficient in the domain or subdomain within the first 6 months of certification. If the predominant view of respondents is that newly

certified nurse anesthetists are not expected to be proficient in the domain or subdomain (scale unit of 0), it would be wise to reevaluate the appropriateness of the topic for the certification examination. However, if respondents indicate that proficiency is expected only after the first 6 months of certification (scale unit of 2), the topic may still be appropriate if, in the judgment of experts, it has pertinence to entry-level practice.

TABLE 2

Criticality and Frequency of Domains and Subdomains

	Criticality Ratings Descriptive Statistics		Rasch Statistics*	Frequency Ratings Descriptive Statistics		Rasch Statistics*
	Mean	Standard Deviation	Measure	Mean	Standard Deviation	Measure
Basic Sciences	2.4	1.2	2.4	3.5	3.7	3.7
Anatomy, physiology, and pathophysiology	2.4	1.2	2.3	3.5	1.1	3.7
Pharmacology	3.0	1.2	2.9	3.6	1.0	3.8
Applied chemistry, biochemistry, physics	1.6	1.1	1.5	2.8	1.3	2.7
Equipment, Instrumentation, and Technology	2.7	1.2	2.7	3.6	3.8	3.8
Anesthetic delivery systems	2.7	1.2	2.7	3.5	1.0	3.8
Airway equipment	3.1	1.2	3.1	3.6	0.9	4.0
Monitoring devices	2.5	1.2	2.5	3.6	1.0	3.8
Basic Principles of Anesthesia	2.8	1.2	2.8	3.6	3.9	3.9
Preoperative assessment & preparation of patient	2.4	1.1	2.4	3.7	0.9	3.9
Fluid/blood replacement	2.5	1.1	2.5	3.5	1.0	3.8
Positioning	2.4	1.1	2.4	3.6	1.0	3.9
Interpretation of data	2.4	1.1	2.3	3.6	1.0	3.8
Airway management, including difficult airway	3.3	1.2	3.2	3.5	1.0	3.9
Local/regional anesthesia	2.4	1.1	2.3	3.0	1.1	3.0
Monitored anesthesia care/conscious sedation	2.6	1.1	2.5	3.5	0.9	3.7
Postoperative pain management	1.8	1.0	1.6	3.0	1.3	2.8
Other techniques	2.0	1.2	1.8	2.8	1.2	2.6
Postanesthesia care/respiratory therapy	2.3	1.2	2.1	2.9	1.3	2.7
Advanced Principles	2.5	1.1	2.4	3.4	3.6	3.6
Surgical procedures and procedures related to organ systems	2.1	1.1	2.0	3.4	1.0	3.6
Pediatrics	2.8	1.2	2.7	2.8	1.1	2.8
Obstetrics	2.6	1.2	2.5	2.7	1.2	2.5
Geriatrics	2.4	1.1	2.4	3.5	1.0	3.7
Obesity	2.4	1.1	2.4	3.4	1.0	3.7
Chronic pain management	1.4	1.1	1.0	1.7	1.4	1.5
Professional Issues	1.5	1.1	1.2	2.1	2.6	2.6
Legal	1.3	1.1	1.0	2.1	1.4	2.1
Research and quality improvement	0.8	0.9	0.1	1.6	1.2	1.5
Professional practice standards	1.6	1.2	1.4	2.6	1.4	2.7
Patient safety	2.6	1.3	2.6	3.4	1.1	3.6

*Raw ratings are positively oriented such that higher scores represent higher levels of criticality and frequency. Rasch analyses transforms these ordinal scores into interval measures which are negatively oriented – lower measures indicate higher levels of criticality/frequency. Thus, to enhance the interpretability of the Rasch measure, the scales were reversed to be positively oriented. The Standard Error for each domain and subdomain was 0.0.

Table 1 reports the counts and percentages for performance expectation for the domains. These data indicate the predominant view that newly certified nurse anesthetists are expected to be proficient in all domains, but there is more disagreement about Advanced Principles of Anesthesia and Professional Issues

than the others. Descriptive statistics were not computed for the performance expectation scale because of its categorical nature.

The five-point rating scales for criticality and frequency are ordinal measures of respondents' endorsement for the domains and subdomains. Because they are ordinal measures, interpreta-

tion of data assumes that the degree of endorsement increases with each greater scale value; that is, the selection of 3 represents stronger endorsement than the selection of 2.

Table 2 contains descriptive statistics for the criticality and frequency of domains. With ratings from 0 to 4, the classic descriptive statistics for criticality indicate that the means, or average scale values, range from 1.5 (minimum to moderate harm) to 2.8 (substantial harm). The standard deviation statistics, which are close to 1, describe the spread of the response distributions, with small estimates indicating relatively tight groupings and large estimates indicating relative diversity of opinion. The fact that 67% of the ratings are within ± 1.2 of the mean suggests reasonable agreement among respondents about criticality.

The findings for the frequency scale indicate respondents perform duties that require proficiency in the domains repetitively. The standard deviations are about 1.2, indicating reasonable agreement. Although Professional Issues has the lowest average rating, it would still be characterized as having relevance at least monthly.

Though a standard deviation of 1.2 for both criticality and frequency indicates a reasonable level of agreement, it should be noted that this standard deviation indicates a level of variability that could potentially allow a criticality or frequency rating to include the rating above or below the point estimate with some degree of confidence (assume 95%).

Though ordinal information and classic descriptive statistics are important and useful, the five points on the criticality and frequency scales cannot be assumed to possess the qualities of an interval scale because they are ordinal measures; that is, they do not represent equal differences. The computation of Rasch statistics converts the data to an interval scale, factoring in respondents' individual propensities to endorse overall. Rasch measures usually are computed to have an average of 0 and standard deviation of 1; however, to establish comparability with the rating scale, Castle reversed the scale, with a mean of 2.75 and standard deviation of 1.

As calculated for Table 2, the Rasch measures should be interpreted such that high values represent strong endorsement and low values represent low endorsement. Taking criticality and frequency into account, the Rasch measures indicate that Basic Principles of Anesthesia is the easiest domain for respondents to endorse, followed by Equipment, Instruments, and Technology. Professional Issues has lower, but still strong, endorsement overall. The standard error of the Rasch frequency and criticality measures was very small (less than 0.05 logits), indicating a high level of precision.

Subdomains

Subdomains, the more specific topic headings in the content outline, denote the information newly certified nurse anesthetists must be required to know to supply proficient anesthesia service.

Respondents evaluated each subdomain using the performance expectation, criticality, and frequency scales.

Table 1 presents percentages for the performance expectation scale for subdomains. A review of the percentages indicates that respondents believe nurse anesthetists must be proficient in the vast majority of subdomains within the first 6 months after certification. There are several subdomains, however, where the opinion is divided: Local/regional anesthesia (technique, physiologic alteration, complications); Postoperative pain management; Other techniques; Chronic pain management; Legal; and Research and quality improvement.

Table 2 contains descriptive statistics of criticality and frequency ratings and criticality and frequency Rasch measures for the subdomains. Again, the standard error of the Rasch frequency and criticality measures was very small (less than 0.05 logits) due to the large sample size. In general, respondents indicated that moderate or greater degrees of harm could result if newly certified nurse anesthetists are not proficient in these areas. Exceptions exist, however: Applied Chemistry, biochemistry, physics; Chronic pain management; Legal; Research and quality improvement; and Professional practice standards are topics where the modal response is either minimal harm or no harm.

Also, respondents indicated that newly certified nurse anesthetists require proficiency in the subdomain quite often. Two subdomains stood apart from the rest. Chronic Pain Management, where the modal response indicates the subdomain is infrequently performed by newly certified nurse anesthetists, and Research and Quality Improvement, where the modal response indicates the concept is applied clinically one time per month. The correlation between criticality and frequency Rasch measures for the subdomains was 0.836, indicating that subdomains performed more often also tended to be areas where the potential for harm was increased if knowledge in the area was not possessed by the nurse anesthetist.

Evaluation of Survey Results

The Practice Analysis Panel met on November 3 and 4, 2011, and again in a follow-up telephone conference with file sharing on December 5, 2011, to review survey findings and evaluate the implications for the content outline. Discussion focused first on the demographic survey and the degree to which the group of qualified respondents aligned with the known characteristics of the population of CRNAs as determined by previous NBCRNA surveys and surveys conducted by the AANA.

Next, the panel reviewed the scales used in the survey, focusing first on the domains. The panel observed that validation data made a strong case for Basic Sciences; Equipment, Instrumentation, and Technology; Basic Principles of Anesthesia; and Advanced Principles of Anesthesia; but that a large portion of respondents saw the performance expectation for the Professional Issues domain as relatively low (63.3% indicated proficiency is

required during the first 6 months of certification). This domain also had relatively low ratings for criticality, so the panel decided to pay close attention to its subdomains.

Most of the panel's attention was devoted to data on subdomains. If less than 75% of the respondents indicated performance expectation in the first 6 months of certification, the panel systematically scrutinized criticality and frequency data to inform discussion and decision making. The panel did not limit discussion just to the subdomains, but discussed the totality of the data. The panel's specific judgments are discussed below.

Applied Chemistry, Biochemistry, Physics

Data account fairly for the opinion of respondents, but the panel believes that this subdomain is valid for the examination. The subdomain was found to be essential in the first 6 months by 78% of respondents. The ratings of zero for performance expectation may indicate that knowledge in these sciences is required even before candidacy for certification. Ratings for criticality and frequency are not insubstantial.

Local/Regional Anesthesia (Technique, Physiologic Alteration, Complications)

Data for criticality and frequency indicate substantial consequence and relevance. The performance expectation data indicate that 73% believe proficiency is entry level, but the only issue in the data is the 22.9% indicating that proficiency in this subdomain is required only after the first 6 months. Detailed data for the knowledge statement survey appear to make a distinction between (a) neuraxial and I.V. regional blocks and (b) peripheral nerve blocks. This distinction may have affected the ratings in the large-scale survey for the subdomain. The subdomain is appropriate.

Postoperative Pain Management

Performance expectation evaluations are lower than 75%, and criticality ratings are not strong. It may be that whether or not the practice of newly certified nurse anesthetists includes postoperative pain management is a function of individual employment setting. The group determined to retain the subdomain.

Other Techniques

Performance expectation evaluations are lower than 75%, and criticality ratings are not strong. It may be that the specific content of the subdomain was not clear to survey participants. The group determined to retain the subdomain and to define it more specifically in the future.

Chronic Pain Management

Performance expectation ratings indicate that the plurality of respondents found that proficiency is required only after the first 6 months. Criticality and frequency data suggest the domain has less consequence and is performed less frequently than oth-

ers. The group decided to drop the subdomain, but to address this issue in the content outline by making the subdomain of Postoperative pain management (Basic Principles of Anesthesia) simply Pain management. The group also decided to add pain theory as a knowledge statement in this subdomain.

Research and Quality Improvement

The data indicate very low endorsement. Checking the previous practice analysis, the group observed that research and quality improvement were calibrated very low on the scale. The group believes that if the label for the subdomain had been Evidence-based practice, the ratings might have been different. The group decided to drop the subdomain.

Test Specifications

Finally, the panel considered several ways that data from the survey might be considered in determining test specifications. Castle computed the product of criticality and frequency ratings for each subdomain and then summed across the subdomains in each domain to give the panel a point of comparison to current and past weights (Kane, Kingsbury, Colton, & Estes, 1989; Lunz, Stahl, & James, 1989; Stahl, Wang, & Muckle, 2003). Using judgment about the various topics in the domains, the group decided that the emphasis given in test specifications to the domains should remain at current percentages, but that (if possible) the sampling strategy for the adaptive test should account for the computed emphasis for subdomains within the domains. Thus, the percentage allocations for domains recommended to NBCRNA were as follows:

Basic Sciences	25%
Equipment, Instrumentation, and Technology	10%
Basic Principles of Anesthesia	30%
Advanced Principles of Anesthesia	30%
Professional Issues	5%

Conclusion

NBCRNA's directors considered the panel's evaluation of the content outline along with the full analysis of data from the practice analysis survey on January 21, 2012. After careful review and deliberation, the Board accepted all panel recommendations about the content outline except that it decided to modify specifications for the examination to exclude the Professional Issues domain and allocate its 5% of content to the Equipment, Instrumentation, and Technology domain. This decision was based on low endorsement of Professional Issues and increased endorsement of Equipment, Instrumentation, and Technology by respondents to this and a 2006 administration of the PPA. Two other considerations entered into the decision to eliminate the Professional Issues domain. The content area is not optimally evaluated by multiple-choice questions, and most examinees are administered a limited number of questions in the Professional

Issues domain, resulting in poor statistical reliability of test scores. Domain-level weights were proposed as follows:

Basic Sciences	25%
Equipment, Instrumentation, and Technology	15%
Basic Principles of Anesthesia	30%
Advanced Principles of Anesthesia	30%

After a 1-month open comment period, in which only four comments were received, the NBCRNA Board ratified the revised NCE blueprint on May 20, 2012, and directed that it be implemented on January 1, 2013.

Full detail of the PPA study can be found in the technical report: *National Board on Certification and Recertification of Nurse Anesthetists Professional Practice Analysis*, available upon request from the NBCRNA.

Anesthetists (NBCRNA); **Karen A. Plaus, PhD, CRNA, FAAN** is the CEO for NBCRNA; **James Henderson, PhD** is executive vice president of CASTLE Worldwide, Inc, Morrisville, North Carolina, and chairs the research and development committee at the Institute for Credentialing Excellence; and **Edward Waters, MN, CRNA**, practices clinical anesthesia at the Kaiser Permanente Woodland Hills Medical Center, is a faculty member of the Kaiser Permanente School of Anesthesia in Pasadena, and is a member of the National Board of NBCRNA.

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