

National Certification Examination (NCE) Professional Practice Analysis

Executive Summary

Published April, 2017

The National Board of Certification and Recertification for Nurse Anesthetists (NBCRNA) is an autonomous body, with multidisciplinary and public representation, that is responsible for specifying the requirements for earning and maintaining of the Certified Registered Nurse Anesthetist credential. In 2016, the NBCRNA conducted a national **professional practice analysis** (PPA) study of the knowledge, skills, and abilities required for entry-level practice as a nurse anesthetist. The purpose of the practice analysis is to maintain a logical, practice-related, and research-based content framework for the NCE.

In a key step central to this effort, NBCRNA appointed a PPA Panel that provided leadership and oversight for the project. NBCRNA convened a group of 12 subject-matter experts (SMEs, see Appendix A) in nurse anesthesia, who were representative of the profession with respect to geography (from across the United States) and practice setting, among other demographic variables, and primarily reflective of those nurse anesthetists who are entering the profession. The group was charged with analyzing the practice of nurse anesthesia at entry level and updating the content outline.

The practice analysis study consisted of the following four major phases, which provide the organization of this report:

- I. Initial Development and Validation. The PPA Panel reviewed and proposed revisions to the domains, tasks, knowledge, and skills specified in the proposed content outline for the NCE. The goal of this stage was to further evaluate the knowledge essential to the proficient practice of nurse anesthesia by nurse anesthetists beyond the point of initial certification. After several small adjustments to the knowledge elements of the content outline, it was converted into an online questionnaire format in order to collect validity ratings.
- II. Pilot Survey. A sample of 44 individuals, including the PPA Panel, reviewed the online survey, which included as survey items the domains, tasks, knowledge, and skills, of the NCE content outline, as well as questions pertaining to the domain weightings of the outline (test blueprint) and demographics relevant to the anesthesia profession. This pilot stage brought about refinements to the survey.
- III. Validation Study. A random sample (N=13,043) of nurse anesthetists within the first five years of initial certification was invited to review and validate the work of the PPA Panel by completing the online survey. A qualified and representative sample of nurse anesthetists provided data in this phase. Of the 13,043 e-mail invitations, just over one-quarter (3,538, or 27.1%) of the recipients clicked the link to the survey, and began it. Of these, 2,164 provided qualified, useful responses, completing at least half of the survey. The sample going forward to analysis represented a 16.6% response rate. The survey was open and available from May 20 – June 13, 2016.

Respondents were asked to evaluate each knowledge element in the content outline, rating them using 5-point scales for criticality and frequency, as well as whether the knowledge element was required of a nurse anesthetist. Criticality was defined as the degree that inability to perform duties related to each knowledge element could be seen as causing harm to stakeholders. Frequency was defined as how often the nurse anesthetist performs duties that require proficiency in each of the knowledge elements.

On June 24-25, 2016 the NCE PPA Panel met in Chicago, IL, to review the results of the PPA survey and to make recommendations for the NCE content outline. The majority of the meeting was devoted to reviewing summaries of ratings of the survey respondents and making decisions about what knowledge statements should be included in the NCE content outline.

Tables 1-3 report descriptive summaries for the three scales for each of the five primary knowledge domains included on the survey. As can be seen in these summaries, four of the five domains exhibited very high endorsement for the Performance Expectation rating, with at least 89% of respondents indicating the specified knowledge was essential within the first 6 months of certification for domains I through IV. The Professional Issues domain also received majority endorsement (62.1%), but markedly lower than the clinical domains.

While space in this executive summary does not permit reporting these indices for every element of the outline, similar summaries of survey ratings were evaluated by the panel for every knowledge statement on the survey.

Table 1. Summaries of Responses for Primary Domains, Required within First 6 Months of Initial Certification

Knowledge Statement	Required w/i 6 mos.
I. Basic sciences	92.0%
II. Equipment, instrumentation, and technology	92.6%
III. General principles of anesthesia	94.8%
IV. Anesthesia for surgical procedures and special populations	89.7%
V. Professional issues	62.1%

Table 2. Summaries of Domain Criticality Ratings

Knowledge Statement	Criticality						
	Mean	SD	Count 1	Count 2	Count 3	Count 4	Count 5
I. Basic sciences	2.9	1.2	302	442	634	371	266
II. Equipment, instrumentation, and technology	3.3	1.3	230	303	557	512	410
III. General principles of anesthesia	3.6	1.3	211	172	438	550	638
IV. Anesthesia for surg. procedures and spec. pop.	3.6	1.3	205	153	524	587	539
V. Professional issues	1.9	1.0	839	696	345	72	47

Table 3. Summaries of Domain Frequency Ratings

Knowledge Statement	Frequency						
	Mean	SD	Count 1	Count 2	Count 3	Count 4	Count 5
I. Basic sciences	4.1	1.2	108	162	272	368	1104
II. Equipment, instrumentation, and technology	4.4	1.1	67	112	174	340	1320
III. General principles of anesthesia	4.6	0.9	48	72	105	220	1566
IV. Anesthesia for surg. procedures and spec. pop.	4.3	1.0	48	95	189	493	1184
V. Professional issues	2.7	1.3	374	606	515	262	249

Based on the ensuing discussion, and the generally high levels of endorsement on almost all elements of the NCE content outline, minor adjustments to the outline were recommended as a result of the survey analysis and subsequent review:

- More broadly-worded categories instead of “laundry lists” under Basic Sciences domain (e.g., lists of specific drugs replaced with drug classifications).
- New “Imaging” subdomain under Equipment, Instrumentation, and Technology
- “Basic Principles of Anesthesia” renamed “General Principles of Anesthesia,” and “Advanced Principles of Anesthesia” renamed “Anesthesia for Surgical Procedures and Special Populations.”
 - Note that there have not been significant changes to these domains; the labels have just been changed to better describe the knowledge areas under those domains.
- The PPA Panel deliberated and extensively discussed whether or not to include Professional Issues (PI) as a fifth domain, as was the case before 2013.
 - PI was included on the PPA survey. Results for Professional Issues topics were similar to previous PPAs (i.e., not as strong support as the other domains on the outline).
 - While the PPA Panel decided not to include PI as a fifth domain, based on the survey results, they did recommend that several topics related to PI be included under General Principles of Anesthesia domain:
 - Ethical considerations
 - Legal issues
 - Safety and wellness
 - Substance abuse (impairment, disorder, and other considerations)
 - Issues surrounding patient safety
 -

IV. Development of Specifications for Assessment. A statistical analysis and subsequent review of the survey ratings of the respondent sample of nurse anesthetists formed the basis for a test blueprint for the NCE. The test blueprint indicates relative emphasis that each domain will receive on the examination and translates into the number of questions an examinee will receive from each core domain. The panel decided to retain the existing percentages.

Table 4. Proposed and Updated Domain Weights

Domain	Original	Updated (No Changes)
I. Basic sciences	25%	25%
II. Equipment, instrumentation, and technology	15%	15%
III. General principles of anesthesia	30%	30%
IV. Anesthesia for surgical procedures and special populations	30%	30%

As a final step, a survey was sent to Program faculty requesting feedback on the list of changes to the outline, the proposed domain weights, and the finalized content outline. All were highly endorsed, and the results were then presented at the Council on Accreditation (COA) on January 19, 2017 and the Assembly of School Faculty on February 24, 2017.

Conclusion

In July 2016, the NBCRNA Board reviewed the work of the PPA Panel and approved the modifications to the NCE content outline, as well as the proposed domain percentages. See Appendix B for the full, updated content outline.

NBCRNA conducted the practice analysis study in order to validate a framework for content development of the NCE, to establish a linkage between the NCE test specifications and actual role requirements of the entry-level nurse anesthetist, and to allow the community of nurse anesthetists to provide input into the design of the NCE.

Knowledge elements of the NCE content outline were validated using scales indicating whether the element is required at or near the time of initial certification (performance expectation), criticality (potential for harm), and frequency (how often used/performed). These data supplied support for decision making about what elements should be retained or deleted from the NCE content outline and how primary domains should be weighted.

Respondent data provided strong evidence of validity for the four domains of the content outline, as well as for nearly all knowledge statements included in the content outline.

Appendix A

2016 NCE Practice Analysis Panel Members

Name	Degree	Position Description	State	Certification Year (Yrs. Exp.)
Chair: Jeremy Heiner, CRNA	EdD	Educator	CA	2004 (12)
Steve Alves, CRNA	PhD	Educator	MA	1993 (23)
Lynn Reede, CRNA	DNP	Administrator	IL	1984 (32)
Nancy Moriber, CRNA	PhD	Educator	CT	1991 (25)
Dayna Sequin, CRNA	MSN	Practitioner	NC	2011 (5)
Michael Trovato, CRNA	MSN	Practitioner	VA	2013 (3)
Ola Akigbogun, CRNA	MSA	Practitioner	TX	2013 (3)
Greg Crawford, CRNA	MSN	Practitioner	CA	2013 (3)
Maggie Blank, CRNA	MS	Practitioner	SD, NH	2014 (2)
Kristin Busing, CRNA	MSN	Practitioner	IL	2014 (2)
Satoya Troncoso, CRNA	MSN	Practitioner	MI	2015 (1)
Amber Van Voorst, CRNA	MS	Practitioner	WI	2014 (2)

NBCRNA Representatives

Timothy J. Muckle, Ph.D., Senior Director of Testing Programs

Matt Ferris, MA, ELS, Director of Test Development

Katie Gottwaldt, Manager of Test Development

Appendix B

National Certification Examination (NCE) Content Outline

- I. Basic Sciences (25%)
 - A. Anatomy, physiology and pathophysiology
 1. Cardiovascular
 - a. Ischemic heart disease
 - b. Valvular heart disease
 - c. Congenital heart defects
 - d. Cardiac conduction and rhythm abnormalities
 - e. Cardiovascular and peripheral vascular complications
 - f. Infectious diseases
 - g. Pericardial diseases
 - h. Cardiomyopathy and heart failure
 2. Respiratory
 - a. Obstructive diseases
 - b. Restrictive diseases
 - c. Infectious diseases
 - d. Pulmonary vascular complications
 - e. Altered airway anatomy
 - f. Genetic respiratory disorders
 3. Central nervous system
 - a. Neurodegenerative diseases
 - b. Myelin diseases
 - c. Cerebrovascular diseases
 - d. Neuropathies and myopathies
 - e. Psychiatric disorders
 - f. Spinal cord disorders
 - g. Intracranial tumor
 - h. Congenital anomalies (e.g., cerebral palsy)
 - i. Seizure disorders
 - j. Genetic nervous system disorders
 - k. Intracranial hypertension
 - l. Thermoregulation
 4. Musculoskeletal
 - a. Myopathies/metabolic complications
 - b. Neuromuscular diseases
 - c. Skeletal diseases
 - d. Musculoskeletal disorders
 - e. Genetic musculoskeletal disorders
 5. Endocrine
 - a. Thyroid and parathyroid disorders
 - b. Pituitary disorders
 - c. Adrenal disorders
 - d. Pancreatic disorders
 - e. Metabolic disorders

- f. Genetic endocrine disorders
- 6. Hepatic
 - a. Infectious diseases
 - b. Biliary tract and bilirubin disorders
 - c. Cirrhotic disorders
 - d. Hepatovascular complications
- 7. Renal
 - a. Primary kidney diseases and disorders
 - b. Acute kidney injury
 - c. Chronic kidney injury
- 8. Hematologic
 - a. Anemias
 - b. Hemoglobin disorders
 - c. Coagulation disorders
 - d. Infectious diseases
- 9. Gastrointestinal
 - a. Esophageal disorders
 - b. Gastric disorders
 - c. Pancreatic disorders
 - d. Intestinal disorders
 - e. Tumors/secreting lesions
 - f. Malabsorption disorders
- 10. Immune
 - a. Infectious disorders
 - b. Hyper- and hypo-immune disorders (allergic response)
 - c. Autoimmune diseases
- 11. Other conditions
 - a. Cancer
 - b. Glaucoma
 - c. Burns
 - d. Trauma
 - e. Substance abuse (alcohol, tobacco, other)
- B. Pharmacology
 - 1. General principles
 - a. Pharmacodynamics
 - b. Pharmacokinetics
 - c. Drug interactions
 - 2. Inhalation anesthetics
 - 3. Intravenous agents
 - a. Barbiturates
 - b. Sedative/hypnotics
 - c. Opioid agonists
 - d. Opioid agonist-antagonists
 - e. Opioid antagonists
 - f. Benzodiazepines
 - g. Benzodiazepine antagonists
 - 4. Local anesthetics
 - 5. Muscle paralytics

6. Anticholinesterase agents
7. Selective relaxant binding agents
8. Neuraxial analgesics
9. Anticholinergics/cholinergic agonists
10. Nonsteroidal antiinflammatory drugs
11. Miscellaneous analgesics
12. Sympathomimetics
13. Inotropes
14. PDE inhibitors
15. Digitalis and related drugs
16. Alpha- and beta-receptor antagonists
17. Antihypertensives
 - a. Sympatholytics
 - b. Centrally acting alpha₂-adrenergic agonists
 - c. ACE inhibitors
 - d. Angiotensin II receptor inhibitors
 - e. Nitrovasodilators
 - f. Nitric oxide
18. Antidysrhythmics
19. Calcium channel blockers
20. Bronchodilators
21. Psychopharmacologic therapy
 - a. Selective serotonin reuptake inhibitors
 - b. Tricyclic antidepressants
 - c. MAO inhibitors
 - d. Lithium
22. Prostaglandins
23. Histamine receptor antagonists
24. Serotonin antagonists
25. Insulin
26. Oral hypoglycemic
27. Diuretics
28. Antacids
29. Gastrointestinal prokinetic medications (metoclopramide)
30. Anticoagulants
 - a. Heparin and low-molecular-weight heparins
 - b. Heparin reversal—protamine
 - c. Antiplatelet medications
 - d. Oral anticoagulants
 - e. Oral anticoagulant reversal
 - f. Thrombolytics
 - g. Thrombin inhibitors
31. Antimicrobials
32. Chemotherapeutics
33. Antiepileptic drugs
34. Antiparkinsonian drugs
35. Lipid-lowering agents
36. Herbal remedies and dietary supplements

- 37. Minerals and electrolytes
- 38. Dantrolene
- 39. Corticosteroids
- 40. Tocolytics
- 41. Uterotonics
- 42. Antifibrinolytics
- 43. Intravenous dyes
- C. Applied chemistry, biochemistry, physics
 - 1. Chemistry
 - a. Aqueous solutions and concentrations
 - b. Acids, bases, and salts
 - c. Chemical reactions: oxidation, reduction, hydrolysis, and conjugation
 - 2. Biochemistry
 - a. Metabolism
 - b. Cellular mechanisms for action
 - c. Drug receptor interaction
 - 3. Physics
 - a. Units of measurement
 - b. Gases and gas laws
 - c. Solubility, diffusion and osmosis
 - d. Pressure and fluid flow
 - e. Electricity and electrical safety
 - f. Vaporization and humidification
 - g. Measurement of oxygen, carbon dioxide, and hydrogen ion
- II. Equipment, Instrumentation and Technology (15%)
 - A. Anesthetic delivery systems
 - 1. High/low pressure gas sources
 - 2. Regulators/manifolds
 - 3. Flowmeters, valves, floats
 - 4. Vaporizers
 - 5. Proportioning systems
 - 6. Pressure failure safety devices
 - 7. Fail-safe devices
 - 8. Ventilator
 - 9. Carbon dioxide absorbent
 - 10. Anesthetic circuits
 - a. Rebreathing, circle system
 - b. Nonrebreathing
 - c. Modified nonrebreathing
 - 11. Pneumatic and electronic alarm devices
 - B. Airway equipment
 - 1. Face masks
 - 2. Laryngoscope
 - a. Rigid
 - b. Videoscope
 - c. Optically enhanced scopes
 - 3. Flexible fiberoptic bronchoscope
 - 4. Endotracheal tube

5. Endobronchial tube
 - a. Including double lumen tubes
 6. Airways
 - a. Oral
 - b. Nasal
 7. Supraglottic airways (i.e., LMA)
 8. Intubating supraglottic airways
 9. Jet ventilation
 10. Intubating stylets
 11. Lighted stylet
 12. Cricothyrotomy (needle and surgical)
 13. Other
 - a. Eschmann catheter (i.e., "bougie")
 - b. Combitube
 - c. Exchange catheter
- C. Monitoring devices
1. Central nervous system
 - a. Evoked potential
 - b. Intracranial pressure
 - c. Modified EEG monitor (BIS, PSArray)
 - d. Cerebral oximetry
 2. Cardiovascular
 - a. Electrocardiogram
 - b. Arterial pressure monitoring
 - c. Noninvasive blood pressure monitoring
 - d. Central venous pressure monitoring
 - e. Pulmonary artery pressure monitoring/ SvO₂
 - f. Cardiac output
 - g. Precordial/esophageal stethoscope/Doppler
 3. Pulmonary/airway monitoring
 - a. Capnography
 - b. Airway gas analysis
 - c. Pulse oximetry
 - d. Airway pressure
 - e. Blood gas analysis
 4. Peripheral nerve stimulator
 5. Urinary output monitoring
 6. Temperature monitoring
 7. Maternal/fetal monitoring issues
 8. Others
 - a. Fluid/blood warmers
 - b. Forced air warming blanket
 - c. Heat and moisture exchanger (HME)
 - d. Blood salvage (cell saver)
- D. Imaging
1. Ultrasound
 2. Fluoroscopy
 3. Radiography

- III. General Principles of Anesthesia (30%)
 - A. Ethical considerations
 - B. Legal issues
 - C. Safety and wellness
 - 1. Substance abuse (impairment, disorder, and other considerations)
 - 2. Issues surrounding patient safety
 - D. Preoperative assessment and preparation of patient
 - E. Fluid volume assessment and management
 - 1. Fluid/blood component therapy replacement
 - 2. Bloodless medicine (including cell saver and hemodilution techniques)
 - F. Positioning
 - 1. Techniques
 - 2. Physiologic alterations
 - 3. Complications
 - G. Utilization and interpretation of data
 - 1. Lab tests
 - 2. Diagnostic exams
 - 3. Intraoperative monitoring data
 - H. Airway management
 - 1. Assessment
 - 2. Techniques, procedures, and devices
 - 3. Complications
 - 4. Difficult airway management
 - 5. Retrograde intubation
 - I. Local/regional anesthetics (technique, physiologic alterations, complications)
 - 1. Anatomy
 - 2. Infiltration
 - 3. Topical
 - 4. Neuraxial blocks
 - 5. Peripheral blocks
 - 6. Other blocks (airway, retrobulbar)
 - 7. Ultrasound and/or nerve stimulator guided concepts and techniques
 - J. Light, moderate, and deep sedation (monitored anesthesia care)
 - K. Pain management
 - 1. Acute
 - 2. Chronic (pathophysiology, techniques, management of patients)
 - a. Pathophysiology
 - b. Techniques
 - c. Management of patients
 - L. Pain theory (anatomy, physiology, pathology, and psychodynamics)
 - M. Other techniques
 - 1. Hypotensive
 - 2. Enhanced recovery after surgery (ERAS)
 - N. Postanesthesia care/respiratory therapy
- IV. Anesthesia for Surgical Procedures and Special Populations (30%)
 - A. Surgical and diagnostic anesthesia, including management of complications
 - 1. Intraabdominal-laparoscopic versus open
 - a. Hepatobiliary system

- b. Gastrointestinal tract procedures
- c. Endocrine organ procedures
- d. Renal/genitourinary
- e. Gynecologic procedures
- f. Peritoneal procedures (including hernia repair)
- 2. Extrathoracic
 - a. Breast
 - b. Plastics and/or reconstructive
- 3. Head
 - a. Extracranial
 - 1) Otolaryngological
 - 2) Ophthalmologic
 - 3) Nasal
 - 4) Craniofacial
 - 5) Plastics and/or reconstructive
 - 6) Orthodontic/dental
 - b. Intracranial
 - 1) Decompression (burr holes, ventriculoperitoneal shunt)
 - 2) Space-occupying lesion
 - 3) Vascular
 - 4) Transsphenoidal hypophysectomy
 - 5) Stereotactic procedures
- 4. Intrathoracic (including open and thoracoscopic approach)
 - a. Diaphragm
 - b. Endoscopic procedures (bronchoscopy, mediastinoscopy)
 - c. Esophagus
 - d. Heart
 - e. Lung
 - f. Mediastinal
- 5. Neck
 - a. Larynx/trachea (including tracheostomy)
 - b. Lymph node biopsies
 - c. Parathyroid/thyroid
 - d. Neck tumors
 - e. Radical neck dissection
- 6. Neuroskeletal
 - a. Cervical spine (anterior and posterior approach)
 - b. Laminectomy/discectomy fusions at all levels
 - c. Pain management procedures
 - d. Spinal cord procedures
 - e. Surgical sympathectomy
 - f. Vertebroplasty
 - g. Scoliosis repair
- 7. Orthopedic
 - a. Arthroscopic procedures
 - b. Closed reduction
 - c. Fractures
 - d. Total joint replacements/arthroplasty

- e. Procedures of the hand and foot
- 8. Perineal and pelvic procedures
 - a. Gynecologic
 - b. Genitourinary
 - c. Anal/rectal
- 9. Vascular (open versus endovascular)
 - a. Carotid
 - b. Thoracic
 - c. Abdominal (including renal)
 - d. Extremity
 - 1) Occlusive disease
 - 2) Vascular access
 - 3) Vein stripping
 - e. Thromboembolic prevention
 - f. Surgical management of portal hypertension
- 10. Diagnostic/therapeutic
 - a. Venous/arterial catheterization
 - b. Interventional cardiology
 - 1) Cardioversion
 - 2) Defibrillation (including AED)
 - 3) Pacemakers
 - 4) Automated internal cardiac defibrillator devices
 - c. Diagnostic imaging
 - d. Electroconvulsive therapy
 - e. Interventional radiology
 - f. Radiation therapy
 - g. Endoscopy
- 11. Other surgical procedures
 - a. Trauma
 - b. Burns
 - c. Resuscitation
 - d. Organ transplants (including management of posttransplant patient for nontransplant surgery)
 - e. Organ procurement
 - f. Laser procedures
- B. Anesthesia for special populations
 - 1. Pediatrics
 - a. Anatomy, physiology, and pathophysiology
 - 1) Normal
 - 2) Prematurity
 - 3) Congenital anomalies
 - b. Pharmacology
 - c. Anesthesia techniques/procedures
 - d. Management of complications
 - 2. Obstetrics
 - a. Anatomy, physiology, and pathophysiology
 - b. Pharmacology
 - c. Anesthesia techniques/procedures

- d. High-risk parturients
 - e. Nonobstetric surgery in the parturient
 - f. Management of complications
3. Geriatrics
- a. Anatomy, physiology, and pathophysiology
 - b. Pharmacology
 - c. Anesthesia techniques/procedures
 - d. Management of complications
4. Obesity
- a. Anatomy, physiology, and pathophysiology
 - b. Pharmacology
 - c. Anesthesia techniques/procedures (including bariatric)
 - d. Management of complications