National Commission for Certification of Anesthesiologist Assistants

Certification Examination Handbook

Certification Process for Anesthesiologist Assistants

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TABLE OF CONTENTS

NCCAA OVERVIEW *5*

NCCAA Mission 5

History 5

Purpose 6

Structure 7

Communications 7

Change of Address 7

Change of Name 8

CERTIFICATION EXAM - GENERAL INFORMATION *8*

Eligibility 8

Education 9

Clinical Experience for Primary Certification 10

Examination Candidacy 10

Eligible Status 11

Ineligible Status 11

Examination Eligibility Process 12

CERTIFICATION EXAM - SPECIFIC INFORMATION *13*

Purpose of the Certification Exam 13

Exam Format 13

Exam Administration Site 14

Exam Content 14

Certification Exam Content Outline *15*

References 36

EXAM REGISTRATION *37*

Exam Dates 37

Fees 38

Registration Process 38

Scheduling Exam via Pearson's Scheduling Platform 39

Name & Contact 40

Accommodations 40

Cancellation 42

CERTIFICATION EXAM ADMINISTRATION *43*
Day of Exam 43
Arrival 43
Identification 43
Security 44
Personal Belongings 44
Test Center Experience Video 45
Test Center Environment 46
Taking the Exam 46
Examination Software 46
Timed Examination 46
Candidate Comments 47
Following the Examination 47
Examination Format 48
Behavior During an Exam 48
POST EXAM ADMINISTRATION *49*
Behavior Following the Exam 49
Issues at Test Center 49
Examination Results 50
Employers & Third Parties 50
Verification of Examination Results 50
Re-registration Process 52
ADMINISTRATIVE ACTION AND APPEALS PROCESS *52*
Inappropriate Behavior 52
Administrative Action 55

NCCAA OVERVIEW

The National Commission for Certification of Anesthesiologist Assistants (NCCAA) is a not-for-profit corporation organized under the laws of the state of Georgia. NCCAA certification provides assurances to the public that Certified Anesthesiologist Assistants (CAA) possess the knowledge, skills and competency to practice as CAAs.

While individual states provide the legal credential for the practice of anesthesiologist assistants, private voluntary certification with the NCCAA indicates compliance with the professional standards for practice as an anesthesiologist assistant. The certification credential for anesthesiologist assistants has been adopted by many health care facilities, practice groups and health systems as a requirement for practice. The certification credential for anesthesiologist assistants has also been recognized in state medical practice acts as well as state administrative rules and regulations.

NCCAA Mission

The mission of the NCCAA is to promote patient safety through certification programs which assess the knowledge, skills and competency of the anesthesiologist assistant and to instill lifelong learning through continuing education requirements.

History

In 1989, a group of five anesthesiologists, two anesthesiologist assistants and one member of the public formed the National Commission for Certification of Anesthesiologist Assistants (NCCAA). Anesthesiologist Assistants had been in practice for a couple of decades. The need for independent credentialing of anesthesiologist assistants was deemed important to:

- Ensure the public of the training, knowledge and skill of anesthesiologist assistants.
- Protect the anesthesiologist assistants in practice by developing and ensuring standards for practice as an anesthesiologist assistant.

Purpose

The purpose of the NCCAA is to ensure that CAAs have the necessary knowledge and skills to practice safely and effectively. In so doing, the NCCAA also protects the value of the CAA credential. The NCCAA is responsible for:

- Establishing and maintaining criteria for the earning of designation as a Certified Anesthesiologist Assistant, including requirements for initial a certification and continued certification.
- Adopting and confirming compliance of initial and continued certification eligibility requirements for certified anesthesiologist assistants.
- Formulating, adopting, and confirming compliance of the requirements for eligibility for admission to NCCAA-administered examinations or assessments including, but not limited to, the NCCAA Certification Exam (CERT) and the NCCAA Continued Demonstration of Qualifications (CDQ) Exam.
- Developing, administering, scoring, and analyzing the NCCAA examination to establish proficient applicants for the credential of Certified Anesthesiologist Assistant.
- Formulating, adopting, and administering NCCAA-created examinations or assessments to candidates who have met all requirements for examination or assessment and have been found eligible.

No national organization can expect to determine the specific procedures that any individual CAA is qualified to perform. Nor can any national organization adequately determine whether an individual CAA may have developed an impairment that could interfere with the proper administration of anesthesia. Ultimately, these judgments must be entrusted to the individual CAA, to those

with whom they work, and those that provide state licensing for CAAs. The NCCAA seeks to protect the public's interest by enacting a plan of certification and recertification on evidence of continued competence in providing anesthesia as indicated by participation in continuing medical education, substantiation of satisfactory performance, and undergoing periodic re-examination to confirm maintenance of current medical knowledge.

Structure

The NCCAA Board of Directors is composed of certified anesthesiologist assistants who hold the NCCAA issued credential of CAA, board certified physician anesthesiologists and representatives of the public.

Communications

Five mechanisms are available for communicating with the National Commission:

- **Website**: www.nccaa.org
- **Email**: contact@nccaa.org
- **US Postal Service**:

  NCCAA
  Box # 160
  8459 US HWY 42
  Florence, KY 41042

- **Phone**: 859-903-0089
- **Direct Message through NCCAA Mobile Application**

Change of Address
The NCCAA maintains on file the mailing address of each applicant/candidate/practitioner as they submit it via the practitioner portal of the NCCAA application. **It is the responsibility of the applicant/candidate/practitioner to maintain accurate contact information, including address, email, and telephone number, with the NCCAA by use of the practitioner portal available on the NCCAA application.**

The NCCAA will not make changes of address based on letterheads, return addresses on envelopes, plain text email requests, etc. The NCCAA will not be responsible for lost or missed communications due to failure by the applicant/candidate/ practitioner to update the NCCAA of a change of address or contact information.

Change of Name
NCCAA maintains on file the name of each applicant/candidate/practitioner as they submit it via the practitioner portal of the NCCAA application. The name on file is used for communications, verification of certification, entrance to testing center, and other documents. **It is the responsibility of the applicant/ candidate/practitioner to maintain accurate name information with the NCCAA by use of the practitioner portal available on the NCCAA application.**

A name change is a two-step process within the NCCAA application. Upon changing a name within the practitioner account, notification must be made via email to contact@nccaa.org before the change of name will appear on the certificate of certification.

The NCCAA will not make changes of names based on letterheads, return addresses on envelopes, plain text email requests et cetera. **NCCAA will not be responsible for lost or missed communications due to failure by the applicant/candidate/ practitioner to update the NCCAA of a change of name or contact information.**

Notification
Communication from the NCCAA via telephone, email or US postal service shall be considered valid notification. The NCCAA will not be responsible for loss of communications by the US Postal Service, facsimile, email, or electronic communication via the NCCAA application.

CERTIFICATION EXAM - GENERAL INFORMATION

Eligibility

Education

To be eligible for **certification**, the candidate must have graduated from an Anesthesiologist Assistant educational program offered at an institution accredited by an agency recognized by the US Department of Education (USDE) or the Council on Higher Education Accreditation (CHEA).

To be eligible for the **Certification Exam**, the candidate must be enrolled in such a program and verified by the program director as progressing on pace toward the expected graduation date. (See Examination Eligibility Process below.)

The certification candidate who will be awarded a Master's degree upon academic program completion must receive academic instruction in the following general content areas:

General content areas must include:

a) Those basic medical sciences that are needed as a foundation for the clinical role of the Anesthesiologist Assistant. In particular, the basic science curriculum must include appropriate content in anatomy, biochemistry, physiology, and pharmacology, with particular emphasis on the cardiovascular, respiratory, renal, nervous, and neuromuscular systems.
b) Medical biophysics appropriate to anesthesia practice, including and emphasizing the principles underlying the function of the devices used in anesthesia delivery systems, in life support systems such as ventilators, and in basic and advanced patient monitors.
c) The principles of patient monitoring emphasizing the design, function, and recognition of artifacts and interpretation of data relevant to anesthesia care.
d) The function of lab instruments and interpretation of data obtained from clinical laboratories, cardiac and pulmonary laboratories.
e) The concepts of data analysis as related to the collection, processing, and presentation of basic science and clinical data in medical literature emphasizing methods that support an understanding of clinical decision-making.
f) Patient assessment, including techniques of interviewing to elicit a health history and performing a physical examination at the level appropriate for preoperative, intraoperative, and postoperative anesthetic evaluations.
g) Extensive instruction in the clinical practice of anesthesia and patient monitoring, principally in an operating room setting, but also in preoperative

areas, postoperative recovery areas, intensive care units, pain clinics, affiliated clinical laboratories and other supporting services.

h) Clinical quality assurance conferences and literature reviews.
i) Competencies in emergency preparedness consistent with professional standards.

Clinical Experience for Primary Certification

The purpose of the National Commission for Certification of Anesthesiologist Assistants (NCCAA) includes ensuring that Certified Anesthesiologist Assistants (CAAs) have the necessary knowledge and skills to practice safely and effectively. For entry-level CAAs, the NCCAA verifies academic qualifications through the program's accreditation status with the Accreditation Review Committee on Education for the Anesthesiologist Assistant (ARC-AA). ARC-AA accreditation confirms that the program's curriculum meets the NCCAA's academic instruction requirements as set forth in ARC-AA *Standards and Guidelines*, Section III(C). Additionally, the NCCAA verifies each candidate's progress toward graduation through a status update process with the program director prior to each exam administration. (See Examination Eligibility Process below.) As a prerequisite for certification eligibility and to maintain and protect the strength of the CAA credential, the NCCAA collects a record of clinical experience from student anesthesiologist assistants (SAAs) to confirm that entry level clinical experience standards are met for new CAAs. Clinical hours and experiences are self-reported to the NCCAA via a digital mobile application. The clinical experience record is reviewed to determine certification eligibility. SAAs are required to complete education and clinical training minimums prior to becoming eligible for board certification by examination. For a complete list of clinical experience requirements see the *NCCAA Standards for Clinical Experience,* available at: https://www.nccaatest.org/2024ClinicalExperienceGuidelinesHB.pdf

Examination Candidacy

The eligibility period for the initial Certification Exam shall extend for no more than two (2) years from the date of the candidate's first certification examination attempt, or from the date of graduation, whichever is earlier. During the period of eligibility, the examination candidate shall have a maximum of six (6) opportunities to take the Certifying Examination. Exam candidates will be responsible for reapplication fees for successive exam attempts while in the eligibility period.

During the eligibility period, the following shall be considered use of an examination opportunity:

1) An examination candidate fails to appear for a scheduled Certifying Examination, or

2) An examination candidate fails to complete a scheduled Certifying Examination, or

3) An examination candidate fails to pass a Certifying Examination.

When either the two-year eligibility period or the maximum six (6) attempts at the Certifying Examination have been exhausted, the candidate loses eligibility to take the Certifying Examination. The only way to establish new eligibility to take the NCCAA Certifying Examination is to enter and complete an unabridged, educational program for anesthesiologist assistants. . The Anesthesiologist Assistant educational program must be offered at an institution that is accredited by an agency recognized by the US Department of Education (USDE) or the Council on Higher Education Accreditation (CHEA).

Eligible Status

A candidate who holds **examination eligible** status with the NCCAA has been verified as meeting the requirements to register for and sit for the NCCAA Certification Exam. Under current procedures, this includes verification by the program director that the candidate is enrolled in an accredited anesthesiologist assistant educational program and is progressing on pace toward the expected graduation date. A candidate with examination eligible status has not yet passed the Certification Exam, has not yet been certified by the NCCAA, and may not use the designation 'CAA' after their name.

Ineligible Status

Candidates will be found ineligible to take the Certification Exam for any one or more of the following reasons:

- The minimum academic and clinical requirements have not been met or adequately documented.

- If, in the sole determination of the NCCAA, the candidate is guilty of cheating on the Certification Exam.

- Failure to make any required eligibility attestations and to provide sufficient documentation to resolve the issue to the satisfaction of the NCCAA.

- Failure to meet any of the other eligibility requirements, including failure to sign or accept a waiver of liability and agreement of authorization, confidentiality and nondisclosure statements if requested by NCCAA.

- Failure to pass the Certification Exam within the two (2) year eligibility period as defined under Examination Candidacy.

Examination Eligibility Process

The NCCAA determines examination eligibility through a multi-step verification process conducted in coordination with accredited anesthesiologist assistant educational programs:

1. **Matriculation Reporting:** Upon student matriculation, the program submits enrolled student information to the NCCAA, including each student's expected graduation date.
2. **Ongoing Status Updates:** The program notifies the NCCAA of any changes to a student's enrollment status, expected graduation date, or other relevant circumstances throughout the student's enrollment.
3. **Pre-Examination Verification:** Prior to each Certification Exam administration, the NCCAA contacts the program director to request a status update on each candidate's progress toward graduation. This verification confirms whether the candidate remains on pace to graduate by the expected date.
4. **Eligibility Determination:** Candidates verified as on pace to graduate are deemed examination eligible and may register for the Certification Exam.
5. **Post-Examination Graduation Verification:** Following a successful Certification Exam result, the NCCAA requests verification of graduation from the program. Certification is conferred only after graduation has been confirmed and all other certification requirements have been met.

Program directors are responsible for providing accurate and timely information at each stage of this process. The forms and communications used for each step are provided by the NCCAA directly to program directors.

CERTIFICATION EXAM - SPECIFIC INFORMATION

Purpose of the Certification Exam

The NCCAA administers the Certification Exam to assess entry-level cognitive and deductive skills of the anesthesiologist assistant.

Exam Format

The certification examination contains 180 items divided into two (2) blocks of 90 items, with 110 minutes to complete the block of items. The examination will be administered in the following format:

- *Pre-test tutorial*: 10 - 15 minutes
- *Examination*: 235 minutes – two (2) 110-minute blocks of 90 items each, with an optional break time of a maximum of 15 minutes to be taken between the first and second examination blocks only.
- *Post-test survey*: 10 - 15 minutes

The items are multiple choice in nature. The items are presented one at a time on a computer screen. Each item may be viewed as long as the candidate desires. The candidate may go back to a previous item, within the current exam block, once an answer choice has been recorded. The candidate may change the answer for a previously answered item within the current exam block; a candidate **may not** re-enter an exam block once completed and submitted.

Exam construction is centered on the concept that the best items have demonstrated acceptable performance. Items not utilized before have unknown performance characteristics. Therefore, it is necessary to pretest items and evaluate their performance. There are 30 such items on the Certification Exam.

These items appear throughout the examination. Items surviving the rigorous evaluation process are retained for use on future examinations. ***The pretest items are not used in the calculation of score for the examination.***

The NCCAA Board of Directors appoints a group of Subject Matter Experts (SMEs) to serve on the Certification Examination Subcommittee. This subcommittee meets annually to draft and review test items for inclusion within the approved item bank. Performance statistics for items are regularly monitored and reviewed for revision, removal or continued use by the NCCAA.

Exam Administration Site

The NCCAA contracts with Pearson to administer the Certification Exam at test centers located throughout the United States, with multiple sites in major metropolitan areas. Pearson is a global leader in exam development and administration, whose solutions deliver a science-based approach to testing across sectors, including certification, education, and licensure.

Exam Content

The NCCAA retains responsibility for the examination content outline and test specifications. Additionally, the NCCAA maintains an item bank of approved exam items and sets the passing score for all exams.

The content for the Certification Exam is validated through a profession-wide national survey professional job analysis (JA) most recently performed in 2021 with expected analysis to occur every 5-7 years. The JA ensures the Certification Exam reflects the knowledge of an entry-level anesthesiologist assistant. Content validation is achieved by linking the JA data with knowledge and skill statements. To complete the process, the items are drafted to meet the examination content outline derived from the JA. The JA is essential to the validation that the Certification Exam is directly job-related, a fair assessment of entry-level knowledge, and legally defensible.

The following examination content outline, developed from responses to the 2021 JA is provided to assist candidates in preparing for the Certification Exam. The exam content outline is only a guide suggesting topics and subject areas used to generate and categorize examination items. The exam content outline is not all-inclusive, as

some elements apply to more than one subject area. Therefore, candidates must validate their knowledge of a subject and must also be able to integrate this knowledge across the spectrum of anesthesia practice to successfully pass the certification exam.

The NCCAA reserves the exclusive right to determine certification examination content, to classify examination items, and to establish the percentage of exam items from each of the related subject areas. For candidate preparation purposes, the approximate percentages of items in each of the six (6) major content areas are provided in the Exam Content Outline.

Certification Exam Content Outline

NCCAA Content Outline

(Rev. 2021)

1. **Principles of Anesthesia (9%)**
    - **A. Preoperative Evaluation**
        1. American Society of Anesthesiologists (ASA) status
        2. Physical examination: heart and lung sounds, predictors of difficult intubation and mask ventilation, mallampati classification, ideal body weight and BMI, obstructive sleep apnea, apnea hypopnea index (AHI) scoring, STOP-BANG scoring
        3. Preoperative tests and labs: ECG testing guidelines, transesophageal echocardiography (TEE), stress test, carotid doppler, holter monitor, cardiac catheterization results, metabolic equivalents (METS), basic metabolic panel (BMP)/chem 7, complete blood count, b-type natriuretic peptide (BNP)
        4. Preoperative medications: indications, drug interactions, adverse reactions, doses, routes of administration, continuation vs. discontinuation of current medications, prophylactic risk reduction, stress dose steroids
        5. Patient allergies, latex allergy (risk factors, detection, management, and prophylaxis)
        6. NPO guidelines

7. Legal/Malpractice: Informed Consent, Living Will, Power of Attorney, DNAR (Do Not Attempt Resuscitation) Orders, Jehovah's Witnesses, Risk Management, Sentinel Events, ASA Closed Claims Project

B. Administration of Anesthesia

1. General anesthesia
    a. Implementation and monitoring: Intravenous vs. inhalational induction, total intravenous anesthesia (TIVA), stages and depth of anesthesia, anesthetic maintenance, ASA monitoring standards
    b. Emergence from anesthesia and postoperative management
        1. Extubation: awake vs. deep extubation, extubation criteria
        2. Postoperative pain management
        3. Postoperative nausea and vomiting (PONV): physiology, causes, risk factors, prevention, pharmacology
        4. Detection and management of post extubation hypoxia (atelectasis, bronchospasm, laryngospasm, residual paralysis, pulmonary edema): bilevel positive airway pressure (BiPAP), chest X-ray, breathing treatments
        5. Emergence delirium
        6. Enhanced recovery after surgery (ERAS) protocols
    c. Complications: light anesthesia, corneal abrasions, blindness, detection and management of malignant hyperthermia
2. Conscious sedation and Monitored Anesthesia Care
    a. ASA guidelines and monitoring standards for sedation, sedation classification (minimal sedation/moderate sedation/deep sedation/MAC anesthesia vs. general anesthesia), modified Ramsay score
    b. Airway obstruction during sedation: detection and management
3. Ventilation under anesthesia

a. Spontaneous vs. control ventilation: advantages and disadvantages
b. Intubation vs. Laryngeal mask airway (LMA) placement
    1. Advantages and disadvantages, contraindications to LMA placement
    2. Proper positioning for intubation
    3. Oral and nasal intubation
    4. Cormack and Lehane laryngoscopy view classification
c. Detection and management of airway complications: soft tissue obstruction, airway swelling, bronchospasm, laryngospasm, post obstructive pulmonary edema, aspiration, airway trauma, airway management for trauma patients, epistaxis
d. Airway equipment
    1. Oral and nasal airways: indications, contraindications and potential complications
    2. Supplemental oxygen devices: nasal cannulas, high flow nasal cannula, simple face mask, non-rebreather mask, Venturi mask,
    3. Ventilation devices: Laryngeal mask airways (LMAs), endotracheal tubes (Murphy eye, bevel, low pressure vs. high pressure cuffs, cuff pressure management, RAE tubes, reinforced tubes, laser tubes, nasal and oral tubes), laryngoscopes and blades, tube exchange devices
e. Difficult airway and airway management techniques: management of the difficult airway, ASA difficult airway algorithm, awake vs. asleep intubation techniques for difficult intubation, fiberoptics, bougies, cricothyrotomy/surgical airway, retrograde intubation, jet ventilation, airway management for foreign body aspiration
f. Airway blocks for awake intubation: superior laryngeal, recurrent laryngeal, transtracheal, glossopharyngeal

4. Patient Positioning

a. Proper positioning, risk factors, complications, and avoidance of injury

5. Temperature Measurement and Control: controlled hypothermia, complications of hypothermia/hyperthermia, shivering, temperature measuring sites, body and fluid warming devices
6. Quality Improvement: Surgical Care Improvement Project (SCIP) Guidelines

C. Fluid Management

1. Estimated blood volume, total body water estimation and calculations, estimated weight loss (EWL), estimated fluid compartments (e.g., intracellular, interstitial, blood), hydrostatic and oncotic pressure, plasma osmolality, molarity and tonicity
2. Hypotonic, isotonic, and hypertonic fluids: indications and potential complications
3. Replacing fluid loss (blood, insensible, deficit, third spacing, and maintenance losses), crystalloids vs. colloids

2. Physiology, Pathophysiology, & Management (19%)

A. Cardiovascular

1. Anatomy and Physiology
   a. Normal anatomy of the heart and major vessels, valves, coronary circulation, cardiac conduction system, innervation, microcirculation (capillary transport, osmotic pressure, viscosity)
   b. Cardiac cycle: control of heart rate, impulse propagation, electrophysiology (ion channels and currents)
   c. Blood pressure: systolic, diastolic, mean pressure, pulse pressure, systemic and pulmonary vascular resistance
   d. Intracardiac pressures: preload and afterload, venous return (vascular compliance, intrathoracic pressure, body position) left ventricular end-diastolic pressure (LVEDP), coronary perfusion pressure, central venous pressure, pulmonary artery pressure, pulmonary artery occlusion pressure

e. Ventricular function: Frank-Starling law, cardiac output determinants and measurements, myocardial oxygen utilization, systolic and diastolic function
f. Regulation of cardiac output, blood pressure, and blood volume: baroreceptors, baroreceptor reflex, Bainbridge reflex, hormonal control
g. Shunts: right-to-left, left-to-right, physiologic
h. Valsalva maneuver: techniques, indications, and physiology

2. Pathophysiology and Anesthetic Management
    a. Coronary artery disease and valvular heart disease, cardiac stenting (bare metal stents vs. drug eluting stents)
    b. Heart failure, cardiomyopathy, idiopathic hypertrophic subaortic stenosis (IHSS), pulmonary hypertension, physiology of patients with heart transplants
    c. Pericardial effusion, cardiac tamponade, and constrictive pericarditis
    d. Pulmonary embolism and air embolism: causes, recognition and management
    e. Hypertension and hypotension: causes and management, intraoperative controlled hypotension
    f. Vascular diseases: abdominal aortic aneurysm (AAA), arterial occlusive disease, thoracic aneurysms (ruptures and dissections)
    g. Mediastinal mass and superior vena cava syndrome
    h. Intracorporeal and extracorporeal ventricular assist devices, extracorporeal membrane oxygenation (ECMO), intra-aortic balloon pump, total artificial heart, anesthetic implications for patients with ventricular assist devices
    i. Shock states: compensated/normotensive shock, decompensated/hypotensive shock, warm shock, cold shock, hypovolemic shock, cardiogenic shock, distributive shock, obstructive shock, dissociative shock
3. Advanced Cardiovascular Life Support (ACLS) and Basic Life Support (BLS)

a. Pharmacology and routes of drug administration (IV/IO/ETT)
b. Resuscitation guidelines, post resuscitation guidelines, and team responsibilities
c. Primary, secondary, and diagnostic assessments (H's and T's)
d. Synchronized cardioversion and defibrillation, pharmacologic cardioversion, automated external defibrillator (AED) vs. manual defibrillator
e. Bradycardia, tachycardia, respiratory arrest, and pulseless arrest algorithms
f. Management of acute coronary syndrome and stroke

4. Cardiovascular Implantable Cardiac Devices (CIEDs): pacemakers, implantable cardioverter defibrillators (ICDs) and cardiac resynchronization therapy (CRT) devices
    a. Temporary, transvenous, permanent, transcutaneous, and subcutaneous CIEDs
    b. Fixed rate, (asynchronous), atrial, ventricular, dual chamber, and biventricular CIEDs
    c. Standard nomenclature for CIEDs
    d. Anesthetic management of patients with pacemakers/ICDs

B. Hematology

1. Blood Transfusion
    a. Products: allogeneic and autologous transfusion, packed red blood cells, irradiated packed red blood cells, leukocyte reduced packed red blood cells, washed packed red blood cells, deglycerolized packed red blood cells, packed red blood cells with nutrient added solution, platelets, apheresis platelets, fresh frozen plasma, cryoprecipitate, fibrinogen concentrate, synthetic antithrombin III, Vitamin K, DDAVP), preservatives in blood products (CPDA, AS-3), whole blood, surgical blood conservation (cell saver, cardiotomy suction, isovolumic hemodilution)

b. Protocols: type and screen, type and crossmatch, antigen typing, blood filters, massive transfusion protocol, emergency transfusion, transfusion protocol for patients with antibodies, calculations, maximum allowable blood loss, ASA task force guidelines
c. Reactions, Complications, and Management: primary and secondary immune responses, hemolytic transfusion reaction, febrile nonhemolytic transfusion reaction, post-transfusion purpura, allergic and anaphylactic reactions, TRALI (transfusion related acute lung injury), uncommon antibody reactions, transfusion associated circulatory overload (TACO), graft vs. host disease, non-immune reactions (hypothermia, fluid overload, electrolyte and acid-base disturbances)

2. Pathophysiology and Anesthetic Management
   a. Anemias and polycythemias, deep venous thrombosis, pulmonary embolism
   b. Clotting disorders: intrinsic and extrinsic coagulation pathways, diffuse intravascular coagulation (DIC), congenital and acquired factor deficiencies, dilutional coagulopathy, fibrinolysis, pharmacologic, hemophilia A & B, von Willebrand disease, antithrombin III deficiency, heparin induced thrombocytopenia (HIT)
   c. Porphyrias and hemoglobinopathies: sickle cell disease, carboxyhemoglobin, methemoglobinemia, β-thalassemia,
3. Pharmacology
   a. Anticoagulation and coagulation therapy
   b. Fibrinolytic and antifibrinolytic therapy
   c. Dual antiplatelet therapy for balloon angioplasty and cardiac stenting
4. Coagulation Lab Values and Management: Intrinsic and extrinsic coagulation pathways, activated clotting time (ACT), international normalized ratio (INR), prothrombin time (PT), partial thromboplastin time (PTT), thromboelastogram (TEG), viscoelastic tests (VET), D-dimer, fibrinogen, platelets

C. Respiratory

1. Anatomy and Physiology
    a. Nose, pharynx, larynx, trachea, lungs, compliance and elasticity
    b. Oxygen consumption and content, oxygen carrying capacity (CaO2), PAO2, PaO2, A/a gradient, carbon dioxide (HCO3-, PACO2, PaCO2, EtCO2), carbon dioxide production, dead space ventilation, alveolar ventilation
    c. V/Q mismatch, dead space, hypoxic pulmonary vasoconstriction, oxyhemoglobin dissociation curve
    d. Basic Radiologic Anatomy: chest X-ray indications and identification (atelectasis, mainstem intubation, pneumothorax, pneumonia, pulmonary edema)
2. Pathophysiology and Anesthetic Management
    a. Obstructive lung disease: asthma, bronchitis, emphysema, cystic fibrosis, lung abscess, Parenchymal: asthma, bronchitis, emphysema, lung abscess, neoplasm, foreign body, trauma
    b. Restrictive lung disease:
        1. Parenchymal (interstitial pulmonary fibrosis/interstitial lung disease, sarcoidosis, acute respiratory distress syndrome, bronchopulmonary dysplasia, pneumonia, atelectasis)
        2. Neuromuscular (muscular dystrophy, amyotrophic lateral sclerosis, myasthenia gravis, myopathy)
        3. Thoracic/extrathoracic (obesity, kyphoscoliosis, ascites, pneumothorax, hemothorax, chylothorax, pleural effusion, empyema, bronchopleural fistula)
    c. Obstructive sleep apnea: complications, management, postoperative strategies and monitoring guidelines
    d. Carbon monoxide poisoning and cyanide toxicity
3. Pharmacology, Respiratory Therapy, and Pulmonary Function Tests (PFTs)

D. Neurologic & Neuromuscular

1. Anatomy and Physiology
    a. Brain, spine and spinal cord, cranial nerves, pain mechanisms and pathways, dermatomes, cerebral blood

flow (effects of pH, $PaCO_2$, and PaO_2), cerebral metabolic rate, autoregulation, cerebral perfusion pressure, molecular transport across blood-brain barrier, neural control of breathing, carotid body, temperature regulation

b. Autonomic (sympathetic and parasympathetic) nervous system, peripheral nervous system
c. Neuromuscular junction and synaptic transmission (pre- and post-junctional components), skeletal muscle

2. Pathophysiology and Anesthetic Management
    a. Brain disorders: stroke and transient ischemic attack (TIA), seizures (clonic, tonic-clonic, focal onset, generalized onset, motor, non-motor), Parkinson's disease, neuroleptic malignant syndrome, Alzheimer's disease
    b. Neurologic depression:
        1. Drug intoxication
        2. Evaluation of neurologic status (Glasgow Coma Scale, AVPU scale, etc.)
        3. Postoperative cognitive dysfunction
    c. Spinal cord injury: paraplegia, quadriplegia, autonomic hyperreflexia, spinal shock, neurogenic shock
    d. Neuromuscular diseases: multiple sclerosis, motor neuron diseases, amyotrophic lateral sclerosis, spinobulbar muscular atrophy, hereditary spastic quadriplegia, Guillain-Barre Syndrome, muscular dystrophies, myotonias, mitochondrial myopathies, myasthenic syndromes (myasthenia gravis, Lambert-Eaton Myasthenic Syndrome, congenital myasthenic syndrome), cerebral palsy

E. Renal & Genitourinary

1. Anatomy & Physiology: blood flow, glomerular filtration, tubular reabsorption and secretions of water, compounds, and electrolytes, renal function tests, hormonal regulation, renal excretion of drugs, electrolyte and acid-base balance, autoregulation and renal perfusion pressure, normal urine output

2. Pathophysiology & Anesthetic Management
    a. Acute and chronic renal insufficiency and renal failure, hemodialysis and peritoneal dialysis, neoplasms, nephrotic syndrome, azotemia, perioperative oliguria and anuria (prerenal, renal, and postrenal failure),
    b. Electrolyte abnormalities (including respiratory and acid-base effects on electrolytes), treatment and anesthetic management of electrolyte disorders
    c. Arterial blood gases (compensated vs. uncompensated respiratory and metabolic acid-base disturbances), lactic acidosis, anion gap, treatment and anesthetic management of acid-base disturbances

F. Hepatic & GI

1. Anatomy & Physiology
    a. Hepatic: blood supply and regulation, mechanism of drug metabolism and excretion, cytochrome P450
    b. GI: peristalsis, bowel obstruction, orogastric and nasogastric tubes, nutrition (enteral and parenteral)
2. Pathophysiology & Anesthetic Management
    a. Hepatic: hepatitis (A, B, C), cirrhosis, portal hypertension, ascites
    b. GI tract: intestinal obstruction, gastroesophageal reflux disease, GI hemorrhage, esophageal varices, GI dysfunction (diarrhea, vomiting, ileus)
    c. Liver transplant and resection, transjugular intrahepatic portosystemic shunt (TIPS) procedure

G. Metabolism, Endocrine, & Immunology

1. Physiology
    a. Hypothalamus and pituitary
    b. Thyroid and parathyroid
    c. Adrenal Medulla, adrenal cortex, and pancreas
    d. Surgical stress response
2. Pathophysiology and Anesthetic Management
    a. Diabetes insipidus
    b. Acromegaly
    c. Inappropriate antidiuretic hormone secretion

d. Hyperthyroidism and hypothyroidism, thyroid storm
e. Cushing Syndrome, Addison's Disease, Hyperaldosteronism, and Hypoaldosteronism
f. Pheochromocytoma
g. Diabetes mellitus, diabetic ketoacidosis (DKA), and hyperosmolar nonketotic syndrome
h. Infection control (general and universal precautions, catheters, nosocomial infections, antibiotic prophylaxis), infections
i. Autoimmune disorders
j. Carcinoid syndrome

3. Immunology
    a. Anaphylactic and anaphylactoid reactions

3. Instrumentation, Monitoring, & Anesthetic Delivery Systems (15%)

A. Cardiovascular Monitoring

1. Arterial lines, central lines, and pulmonary artery catheters
    a. Indications, contraindications, and potential complications
    b. Equipment, insertion techniques, sites of insertion
    c. Monitoring: arterial blood pressure, central venous pressure (CVP), pulmonary artery pressure (PAP), pulmonary artery occlusion pressure (PAOP)
2. Pressure transducers: monitoring accuracy, zeroing, effects of gravity, resonance and damping
3. Cardiac output: fick principle, thermodilution, mixed and central venous oxygen saturation, calculation of SVR and PVR
4. ECG: normal and abnormal rhythm interpretation and management
5. Noninvasive blood pressure (NIBP) monitoring: oscillometry and continuous non-occlusive
6. Stroke volume variation monitoring: effects of mechanical and spontaneous ventilation, pulsus paradoxus, stroke volume index, monitoring requirements, fluid management
7. Principles of Doppler ultrasonography and echocardiography; use with IVs, arterial lines, central lines, and peripheral nerve blocks

B. Neurophysiologic Monitoring

1. Electroencephalography (EEG) and bispectral index (BIS) monitoring, evoked potentials (SEEPs, MEPs, BAEPs, VEPs), cerebral oximetry, intracranial pressure (ICP)
2. Peripheral nerve stimulators, nerve stimulator patterns, and anesthetic implications: single twitch, train of four, tetanus, double burst stimulation, post tetanic count, fade, supramaximal stimulus, direct muscle stimulation, differences in nerve monitoring sites, indicators of adequate reversal

C. Respiratory Monitoring

1. Capnography (colorimetric, continuous waveform)
2. Pulse oximetry
3. Co-oximetry

D. Anesthesia Machine & Circuits

1. Anesthesia Machine
    a. Components: wall supply and gas cylinder supply of gases, pin index safety system, diameter index safety system, high pressure and low pressure pathways, flowmeters and vaporizers (safety features, proportioning devices, vapor pressure, gas concentrations, calculation of FiO2), spirometer, spectrometer, active and passive scavenging, suction, pressure fail-safe, machine alarms and management
    b. Ventilators
        1. Modes of ventilation: assist-control, controlled ventilation, pressure limited, volume limited, intermittent mandatory ventilation (IMV), synchronized intermittent mandatory ventilation (SIMV), pressure support ventilation (PSV), autoflow ventilation, high frequency and jet ventilation
        2. Ventilator settings: respiratory rate, tidal volume, I:E ratio, peak inspiratory pressure, PEEP, CPAP, bilevel positive airway pressure (BiPAP), fresh gas coupling
2. Anesthesia Circuits

a. Systems: circle systems (closed, semi-closed, adult, pediatric), non-circle systems (insufflation, open, semi-open/Mapleson): indications for use, advantages and limitations for each type of circuit
b. Components: connectors and adaptors (elbow, Y-piece), masks, endotracheal tubes, reservoir bags, unidirectional valves, inspiratory and expiratory tubing, coaxial circuits, airway pressure relief valve, carbon dioxide absorbers (types of absorbent, canisters, efficiency, compound A, carbon monoxide poisoning)
c. Circuit performance: resistance, laminar and turbulent flow, dead space (anatomic, mechanical, and physiologic), rebreathing, compliance, leaks, gas mixtures, humidity, heat

E. Physics & Mathematics

1. Fresh gas flow calculations: fresh gas coupling, inspiratory and expiratory flow rates through anesthesia circuits, E cylinder volume calculations
2. Properties of anesthetic gases and fresh gas flow gases
3. Flow, resistance, diffusion, gas laws and partial pressures
4. Fire and explosion hazards, prevention and management of airway fires, radiation safety, lasers and laser safety
5. Electricity, electronics, and electrical safety:
    a. Ohm's law, direct and alternating current, hot/neutral/ground wires, leakage current, short circuits, microshock, macroshock, line isolation monitor
    b. Unipolar and bipolar cautery, "grounding pad," and harmonic scalpel

4. Subspecialty Care (31%)

A. Obstetrics & Perinatal Management

1. Maternal-Fetal Physiology and Anatomy
    a. Respiratory and acid-base changes during pregnancy
    b. Cardiovascular and hematologic changes during pregnancy
    c. Gastrointestinal and renal changes during pregnancy
    d. Central nervous system changes during pregnancy

    e. Fetal oxygenation: uterine and placental blood flow and gas exchange, aortocaval compression, supine hypotensive syndrome
    f. Physiology of labor and delivery, stages of labor
2. Pathophysiology and Anesthetic Management
    a. Anesthesia for non-laboring pregnant patients
    b. Anesthesia for complicated pregnancy: diabetes, hypertension, cardiac diseases, fetal demise, ectopic pregnancy, cerclage, placenta previa/accreta, aspiration, multiple pregnancy, abruptio placenta, retained placenta, cord prolapse, uterine atony, breech presentation, disseminated intravascular coagulation, eclampsia and preeclampsia, HELLP syndrome, embolic disorders (amniotic fluid embolism, DVT and pulmonary thromboembolism), antepartum and postpartum hemorrhage, preterm labor, multiple gestation pregnancy
3. Anesthesia in the Obstetric Unit
    a. Pregnancy definitions: preterm labor, age of viability, gravida/para (G/P)
    b. Pharmacology and fluid therapy: teratogens, uterotonic and tocolytic therapy, neuraxial drugs
    c. Fetal/newborn monitoring: cardiotocography, scalp blood analysis, APGAR score
    d. Labor analgesia and anesthetic techniques: epidural, spinal, combined spinal/epidural, dural puncture epidural, continuous spinal anesthesia, management of ineffective epidurals, pudendal and paracervical nerve blocks, IV analgesics, nitrous oxide
    e. Anesthetic management for caesarean section (C-section): unplanned C-sections, emergency C-sections, C-sections with spinal anesthesia, C-sections with epidural anesthesia, C-sections with general anesthesia
    f. Management of complications: ineffective epidurals, difficult airway algorithm for laboring patients, high spinal, hemorrhage, patchy blocks, inadvertent dural puncture and post dural puncture headache

4. Pharmacology: anesthetic drugs and placental transfer (effects on fetus and newborn), drug interactions and potential teratogens, oxytocic and tocolytic drugs

B. Pediatrics & Neonatal

1. Anatomy and Physiology
    a. Fetal blood flow pathway: persistent fetal circulation, transition from fetal circulation to adult circulation, patency of ductus arteriosus and foramen ovale
    b. Respiratory: development, surfactant, difference in lung volumes and airway anatomy in adults vs. neonates
    c. Cardiovascular: fetal hemoglobin, anemias, sickle cell disease, hemolytic disease of the newborn, rhogam
2. Pathophysiology and Anesthetic Management
    a. Congenital heart defects: Ebstein's anomaly, coarctation of the aorta, interrupted aortic arch, hypoplastic left heart syndrome, tetralogy of Fallot, transposition of the great arteries, total anomalous pulmonary venous return, tricuspid atresia, pulmonary atresia, truncus arteriosus, atrioventricular canal defect, double outlet right ventricle, vascular rings, dextrocardia, Blaylock Taussig (BT) shunts, Norwood procedure, Fontan procedure, Ross procedure
    b. Other congenital defects: Down's syndrome (Trisomy 21), Pierre Robin syndrome, Treacher Collins syndrome, vascular rings, tracheoesophageal fistula (TEF)
    c. Respiratory/airway: respiratory distress syndrome, upper respiratory infection (URI), cystic fibrosis, bronchopulmonary dysplasia, choanal atresia, diaphragmatic hernia, tracheoesophageal fistula, prematurity, asthma
    d. Neuromuscular: muscular dystrophy, cerebral palsy, scoliosis, tethered cord, skeletal abnormalities (Marfan syndrome, osteogenesis imperfecta), meningocele, myelomeningocele, spina bifida, nerve palsies
    e. Gastrointestinal: esophageal atresia, pyloric stenosis, necrotizing enterocolitis, omphalocele, gastroschisis
3. Pediatric Anesthesia

a. Pediatric equipment, endotracheal tube selection and depth
b. Premedication, induction techniques, anesthetic differences from adult
c. Fluid management and blood replacement, estimated blood volume, transfusion protocol
d. Anesthetic management for pediatric procedures
e. Management of complications

4. Pediatric Advanced Life Support (PALS)
    a. Pharmacology, fluid therapy, resuscitation and post resuscitation guidelines
    b. Management of the cardiac scenarios (bradycardia, tachycardia, Vfib/pulseless Vtach, asystole/PEA), synchronized cardioversion and defibrillation
    c. Management of the shock scenarios
        1. Hypovolemic shock
        2. Cardiogenic shock
        3. Distributive shock (anaphylactic shock, septic shock, neurogenic shock)
        4. Obstructive shock (tension pneumothorax, cardiac tamponade, pulmonary embolism, ductal dependent lesions)
    d. Management of the airway scenarios
        1. Upper airway obstruction (laryngospasm, stridor, croup, soft tissue obstruction, epiglottitis
        2. Lower airway obstruction (asthma, anaphylaxis)
        3. Lung tissue disease
        4. Disordered control of breathing

C. Geriatric

1. Physiology (CNS, cardiovascular, respiratory, renal and hepatic changes), pathophysiology, pharmacologic implications, anesthetic considerations, management of complications

D. Otolaryngology, Plastic Surgery, & Ophthalmology

1. Otolaryngology: tonsillectomy and adenoidectomy, ear procedures, airway foreign bodies, diagnostic and therapeutic laryngoscopy

2. Plastic surgery: cleft lip and palate, craniofacial procedures, Lefort fractures
3. Ophthalmology: strabismus, cataracts, corneal transplant

E. Orthopedics

1. Scoliosis, joint replacement, hip and long bone fractures, shoulder arthroscopy, methylmethacrylate, fat embolism

F. Anesthesia Outside the Operating Room

1. Radiology, gastrointestinal endoscopy, Cath Lab
2. Anesthesia for electroconvulsive therapy (ECT)

G. Trauma

1. Trauma and Burns

H. General Surgery & Bariatrics

1. Laparoscopic procedures: positioning, subcutaneous emphysema, gas embolism, cardiovascular effects of peritoneal insufflation
2. Bariatrics: physiology, pathophysiology, pharmacology, anesthetic considerations and management, management of complications, postoperative management

I. Cardiothoracic & Vascular Surgery

1. Coronary artery bypass graft (CABG), on pump and off pump techniques, open valve replacement, endovascular valve replacement, hybrid coronary revascularization, surgery on the ascending and descending aorta, cardiac transplantation, ventricular assist device placement, pericardiocentesis, pericardial window, left atrial appendage closure, transmyocardial laser revascularization, laser lead extraction, mediastinoscopy, excision of mediastinal mass, aortogram, surgery on the abdominal aorta, lower extremity occlusion surgery, etc.
2. Cardiopulmonary bypass: components of the bypass machine, venous and aortic cannulation techniques, aortic cross clamping, priming solutions, antegrade and retrograde cardioplegia, hemodilution, anticoagulation and antifibrinolytic therapy, deep hypothermic circulatory arrest and cerebral protection techniques, normothermic antegrade cerebral perfusion, open vs. closed bypass systems, miniature

cardiopulmonary bypass systems, partial cardiopulmonary bypass, left heart bypass, right heart bypass, myocardial preservation, advantages, disadvantages, and complications of bypass

3. Anesthetic steps to on-pump cardiothoracic surgery
4. Thoracic Surgery: anesthetic considerations and management, lung isolation techniques, and management of one lung ventilation

J. Ambulatory Surgery

1. Aldrete scoring, PACU phase I, phase II, contraindications
2. Complications in PACU

K. Gastrointestinal

1. EGD, ERCP, colonoscopy

L. Neurosurgery

1. Anesthetic considerations and management for increased ICP, herniation, cerebral ischemia, positioning, air embolism, anesthetic and ventilator effects on cerebral blood flow
2. Anesthesia for brain and spine surgery: anesthesia for brain surgery: craniotomy, transsphenoidal approaches; ventriculoperitoneal (VP) shunts), aneurysms and arteriovenous malformations, cerebral vasospasm, seizure focus ablation
3. Clinical application of somatosensory evoked potentials (SSEP), motor evoked potentials, brainstem auditory evoked potentials, and visual evoked potentials
4. Cerebral and spinal cord protection: blood pressure and end tidal CO2 control, IV fluid management and selection, cerebral autoregulation, hypothermia, pharmacologic, spinal fluid drainage

M. Genitourinary and GYN

1. Cystoscopy, transurethral resection of the prostate (TURP), transurethral resection of bladder tumor (TURBT), extracorporeal shock wave lithotripsy (ESWL), ureteral implantation, bladder and ureteral malformations, urinary diversion surgery (ileal conduit, neobladder reconstruction)

2. Anesthesia for renal surgery and surgery associated with renal failure: arteriovenous fistulas/grafts, renal transplants, Wilms tumor, partial and total nephrectomy
3. Ectopic pregnancy, dilation and curettage

N. Critical Care

1. Systemic inflammatory response syndrome and sepsis
2. Ventilator assisted pneumonia (VAP)
3. Invasive line changes
4. Basic image interpretation (chest X-ray): endotracheal tube and mainstem intubation, nasogastric tube position, central line position, pacemakers and implantable cardioverter defibrillators, lucency and opacity, costophrenic angles and hemidiaphragm, anterior-posterior vs. posterior-anterior imaging, increasing image quality, hyperinflation, pneumothorax, pulmonary edema, pleural effusion, septal (Kerley) lines, cardiac hypertrophy
5. TPN and feeding
6. Consequences of ICU sedation
7. Weaning from intubation and rapid shallow breathing index
8. Glycemic control

5. Pharmacology (18%)

A. Pharmacokinetics & Pharmacodynamics

1. Routes of elimination, differences in dosing amongst age groups

B. Inhalational Anesthetics

1. Effects on central nervous system (CNS), circulation, respiration, neuromuscular function, renal function, hepatic function; nitrous oxide and closed spaces, adverse effects and side effects, operating room pollution
2. Onset, potency, and emergence: inhalational induction speed, blood: gas coefficients, Ostwald coefficient, Minimum Alveolar Concentration (MAC), Fa:Fi curve, concentration effect, second gas effect, washout of inhalational agents

C. Anesthetic Maintenance Agents

1. Intravenous (IV) induction agents

a. Indications and contraindications, mechanism of action, metabolism and excretion
b. Effects on circulation, respiration, CNS; adverse effects and side effects

2. Muscle relaxants
    a. Indications and contraindications, complications, mechanism of action, biotransformation and excretion, prolongation of action,
    b. Drug interactions (antibiotics, antiepileptics, magnesium, inhalational anesthetics) and potential side effects (pseudocholinesterase deficiency, muscle soreness, etc)
    c. Monitoring techniques, antagonism of blockade, residual paralysis, muscle soreness

D. Local Anesthetics

1. Indications and contraindications, mechanism of action, biotransformation and excretion, potency and prolonged action
2. Toxicity: CNS (seizures, cauda equina syndrome, transient neurologic symptoms), cardiac, allergic, preservatives, allergic reactions, methemoglobinemia
3. Onset and duration, ionization, lipid solubility, pKa

E. Cardiovascular Drugs

1. Neurotransmitters, types of receptors, target organs, agonists, antagonists, tocolytic uses
2. Inotropes, vasodilators, vasoconstrictors, antianginal, and antiarrhythmics
3. Cholinergic Agents, Anticholinergic Agents, and Cholinesterase Agents: neurotransmitters, muscarinic and nicotinic effects, Cholinergic Crisis, Anticholinergic Syndrome

F. Non-Anesthetic Drugs and Adjuncts to Anesthesia

1. Analgesics and reversal agents: opioids, opioid agonist-antagonist, opioid receptors, anti-inflammatory drugs, Tylenol/Ofirmev, opioid antagonists
2. Sedatives and reversal agents: benzodiazepines, barbiturates, antihistamines, dissociative agents, alpha-2 agonists, and benzodiazepine antagonists

3. Toxicology, drug and alcohol abuse, delirium tremens, marijuana use
4. Glucose control: oral hypoglycemics, insulin, dextrose
5. Diuretics: mechanism of action, adverse effects, effects on electrolytes and acid-base balance
6. Antibiotics: indications and contraindications, mechanisms of action, adverse effects
7. Anesthetic implications for the following chemotherapy agents: Bleomycin, doxorubicin, and the following platinum-based agents: cisplatin and carboplatin
8. Anesthetic implications for the following herbal medications: ginkgo, garlic, ginseng, St. John's wort, saw palmetto, soy, ephedra, kava
9. Miscellaneous drugs: antidepressants, butyrophenones, anti-Parkinson drugs, anticonvulsants, antiemetics, physostigmine

6. Regional Anesthesia & Pain Management (8%)

A. Chronic & Acute Pain Management

1. Differential blockade
2. Types of pain (nociceptive, non-nociceptive, somatic, visceral, sympathetic, reflex sympathetic dystrophy, neuropathic, allodynia, dysesthesia, phantom limb, psychogenic, hyperalgesia) and common treatments
3. Opioids for chronic pain management

B. Peripheral Nerve Blocks

1. Autonomic: stellate ganglion, celiac
2. Head and neck: cervical plexus
3. Upper extremities: brachial plexus (interscalene, anterior suprascapular, supraclavicular, infraclavicular, axillary), musculocutaneous, intercostobrachial, wrist (radial, ulnar, median), and digital blocks
4. Torso: transversus abdominis plane (TAP), quadratus lumborum, rectus sheath, ilioinguinal, iliohypogastric, intercostal, paravertebral, serratus plane, and pectoralis blocks
5. Hip and lower extremities: fascia iliaca, femoral, sciatic (transgluteal & popliteal approaches), saphenous (adductor

canal), single puncture dual injection (SPEDI), infiltration between popliteal artery and capsule of the knee (IPACK), and ankle blocks
6. IV regional anesthesia
7. Nerve stimulator equipment: insulated vs. bare needles, threshold current, short bevel vs. long bevel needles
8. Contraindications to peripheral nerve blocks

C. Neuraxial Blocks

1. Indications, contraindications, complications, insertion techniques
2. Onset, test dose, duration, sites of action, and termination of action
3. Neuraxial dosing of drugs, baricity, preservatives in local anesthetics
4. Epidural and spinal trays
5. Neuraxial blocks for patients on blood thinners
6. Contraindications to neuraxial blocks

D. Ultrasonography & Anatomic Landmarks

1. Ultrasound probes: sound waves and ultrasound waves, echogenicity, hyperechoic, hypoechoic, isoechoic, anechoic, frequency, gain, color flow, depth, in plane vs. out of plane, short axis vs. long axis

References

The principal anesthesia textbooks used in anesthesiologist assistant educational programs should provide information related to all the major content areas on the Certification Exam. Research articles and review books are not used as references for item development. The NCCAA does not sponsor or endorse any review courses, review manuals or texts (primary or review) for Certification Exam preparation. The NCCAA does not release previously utilized exams or retired items. Below is a list of common texts utilized in exam item development. If no edition noted, the most recent edition in print is utilized.

Morgan & Mikhail's Clinical Anesthesiology, Butterworth and Mackey

Miller's Anesthesia, Gropper

Anesthesiology, Longnecker

Clinical Anesthesia, Barash

Anesthesiology, Problem-Oriented Patient Management, Yao & Artusio

Stoelting's Anesthesia and Co-Existing Diseases, Hines and Jones

Pharmacology and Physiology for Anesthesia, Hemmings and Egan

Benumof and Hagberg's Airway Management, Hagberg

Anesthesiologist's Manual of Surgical Procedures, Jaffe

A Practical Approach to Anesthesia Equipment, Dorsch and Dorsch

Anesthesia and Uncommon Diseases, Fleisher

Textbook of Medical Physiology, Guyton and Hall

EXAM REGISTRATION

Exam Dates

The Certification Exam is currently offered three (3) times per year and may be taken after the candidate has been deemed eligible by the NCCAA and has scheduled an appointment with Pearson to take the exam. The exam dates for the upcoming calendar year may be found at the bottom of the website at www.nccaa.org, in the candidate's individual profile following secure log in to the NCCAA mobile app.

Candidates may schedule an appointment to take the Certification exam on any date within the examination window at a Pearson test center of their choice. A list of centers may be found at https://www.pearsonvue.com/us/en/nccaa.html.

Particular attention should be paid to the fact that not all test centers are open seven (7) days a week or operate on the same daily schedule. Further, availability of accommodations varies among test centers.

Fees

The Certification Exam registration fees (at time of publication) and other applicable fees are listed below. All fees must be paid electronically through the NCCAAA application, unless specified by NCCAA. All fees must accompany the appropriate online registration information. Institutional checks, personal checks or money orders will not be processed. NCCAA does not directly invoice individuals for payment of any examination fees. Payment must be paid via institutional ACH or credit card.

Registration: $1400
Late Registration: $1775
Retake registration: $150
Score Verification: $100

Registration Process

Prior to each exam administration, the NCCAA will request a status update from the candidate's Program Director to verify that the candidate is progressing on pace toward the expected graduation date. This verification is required for the NCCAA to confirm examination eligibility and to authorize the candidate to register for the Certification Exam. (See Examination Eligibility Process for details.) Upon confirmation of exam eligibility, exam candidates will register for the Certification Exam through their individual, secure NCCAA accounts via the mobile application. To access registration:

- Log into your NCCAA account on the mobile application.
- Click the Certification Exam link, then select the exam administration.
- Registration is open during select timeframes, as listed within the Certification Exam link.
    - Once selected, follow the steps to sign the NDA form, complete the required fields and submit payment via credit card.

- The receipt for exam fees will not be sent via email; rather it is permanently stored and available via the 'Receipts and Results' page on the app.

It is the exam candidate's responsibility to proofread the contact information as entered to ensure receipt of all Pearson and NCCAA communication regarding the exam.

To initiate the process of scheduling exam, click on the "Book Testing Center Now" button. The system will then connect you directly to Pearson's scheduling platform.

Scheduling Exam via Pearson's Scheduling Platform

Once candidate is connected to Pearson's scheduling platform:

- Select "Schedule an exam" on the main page, then click on Cert: Certification Exam.

- On the next page, review the NCCAA Policies and "Agree". A list of testing centers will populate at the bottom of the page based upon your zip code. Use the search function to change populated testing center locations.

- Click on the preferred testing center to see available appointments and select a date and time. Click "Submit" at the bottom of the page to secure your appointment. If candidate does not finalize the process by clicking "Submit", the appointment will not be reserved.

- An automated confirmation email containing the exam appointment details will be generated and sent to the candidate's email.

To reschedule or cancel an exam, the candidate will log into their NCCAA account and scroll to the bottom to click on the "View Details" button, which will display a synopsis of the current appointment. Select the "Reschedule" button, at which time the system will connect to Pearson's scheduling platform wherein availability may be viewed before proceeding to reschedule the current appointment. The new appointment will not be finalized until "Submit" is selected at the bottom of the page.

All aspects of what to expect in a Pearson test Center can be found at: https://www.pearsonvue.com/us/en/test-takers/pearson-professional-center-tour.html.

Name & Contact

The name entered by the candidate in their individual secure NCCAA profile is the name that is submitted to Pearson on the eligibility file.

When a candidate appears at the Pearson test center, the first and last name, as they appear on the original NCCAA eligibility notification received by Pearson, and one government-issued photo identification must match.

Candidates will not be allowed to take the exam if their photo identification does not bear the same first and last names as their eligibility file shows at the Pearson test center.

Name or address changes are not accepted at the Pearson test center. If a candidate changes his or her name and/or address after the registration for an NCCAA exam has been received, the NCCAA should be notified of the change immediately by email at contact@nccaa.org.

Accommodations

The NCCAA complies with the Americans with Disabilities Act (ADA) and is committed to providing appropriate accommodations for exam candidates with documented physical or mental impairments that substantially limit one or more major life activities. The NCCAA may also approve and provide accommodations for exam candidates with documented medical conditions that may be temporary or are not covered by the ADA.

The NCCAA has established a process to consider requests from applicants that a Certification Examination be administered to them under nonstandard conditions because of medical, religious, or other reasons. The steps include:

1) Initiate the request by contacting NCCAA at contact@nccaa.org.

2) Provide clear, legible copies of all supporting documentation for your request, including documentation of prior exam accommodations.

   Supporting Documentation Requirements:

   Appropriate supporting documentation of a disability or qualifying temporary medical condition from a qualified medical professional must be submitted to NCCAA.

   A qualified medical professional is defined as an individual with the education, training, and expertise to diagnose the reported disability. The relationship of the attesting professional to the individual must be that of a treating medical professional to a patient. There must be no familial, intimate, supervisory, or other close relationship between the qualified professional and the individual requesting the accommodation.

   Further, the documentation must:

   - Be on letterhead, signed, dated, and include the name, title, and professional licensing credentials of the qualified medical professional providing the report.

   - Contain contact information including address, telephone number and e-mail address of each professional providing documentation.

   - Include the date of assessment upon which each professional's report is based and any relevant follow-up dates. Documentation recency must be within two (2) years of the request for accommodations.

   - Include a detailed description of the medical, psychological, educational, and/or cognitive functioning tests that were conducted, the results of those tests, and a comprehensive interpretation of the results.

   - Provide the name of the specific disability or medical condition and a description of the specific impact on daily life activities and day-to-day functional limitations to major life activities. This includes a history of the impact of the disability on academic functioning if the disability is due to a learning disability or attention deficit/hyperactivity disorder.

- Indicate the specific examination accommodations that are recommended and how each will compensate for those limitations and reduce the impact of the identified limitations.

3) After the NCCAA has received and reviewed the documentation, the applicant must comply with any additional requests for documentation of support, including prior exam accommodations utilized by the applicant. If accommodation is approved, the NCCAA will provide the details of the accommodation.

4) The NCCAA will notify the exam vendor of the accommodation and work with the applicant to complete the application and scheduling process.

The NCCAA must receive written notification of the requested special accommodations for examination administration and the rationale **at the time of application**. The NCCAA reserves the right to request further information from the applicant's physician, Program Director, or other persons concerning the reason and requirements for nonstandard conditions for examination administration.

The decision to accommodate a request that is not covered by the ADA remains at the sole discretion of the NCCAA.

Cancellation

There are no refunds issued for any of the following reasons:

- Not scheduling the exam with the Pearson test center following registration with the NCCAA

- Canceling a scheduled examination less than 72 hours in advance of the date and time of the scheduled appointment

- Arriving more than 15 minutes after the scheduled starting time for the exam

- Failing to appear for the scheduled exam

The previous registration fee cannot be applied to another examination.

If the candidate experiences an emergency, they must provide the NCCAA with a written description and documentation of the emergency for review by email at contact@nccaa.org. Requests must be submitted within 24 hours of the scheduled exam date. Refunds are subject to a $100 administration fee.

*Examples***:** Failing to bring the required current, valid photo identification is not considered an emergency. Failing to accurately record correct date, time or location for the scheduled exam appointment is not considered an emergency.

CERTIFICATION EXAM ADMINISTRATION

Day of Exam

Arrival
The candidate should arrive at the Pearson Test Center at least 30 minutes prior to the scheduled test time. **The candidate who arrives at the test center more than 15 minutes after scheduled test time will not be admitted.**

Identification
To gain admission to the Test Center, the candidate must present one (1) valid (current) form of government-issued identification that includes their name and photograph. No form of temporary identification will be accepted. The candidate will also be required to sign a roster for verification of identity.

- Examples of valid forms of identification are a driver s license with photograph; state identification card with photograph; passport; or military identification card with photograph.

- If the first and last name on the registration is different than it appears on their identification, the candidate must bring proof of their name change (e.g., marriage license, divorce decree or court order).

Candidates must have proper identification to gain admission to the Test Center. Failure to provide appropriate identification at the time of the examination is considered a missed appointment. There will be no refund of examination fees.

Security
Pearson administration and security standards are designed to ensure all candidates are provided the same opportunity to demonstrate their abilities. The Test Center is continuously monitored by audio and video surveillance equipment for security purposes.

The following security procedures apply during the examination:

- Examinations are proprietary. No cameras, tape recorders, pagers or cellular/smart phones are allowed in the testing room. Possession of a cellular/smart phone or other electronic devices is strictly prohibited and will result in dismissal from the examination.

- No calculators are allowed. If a calculator is needed, it will be provided via the test delivery software.

- No guests, visitors or family members are allowed in the testing room or reception areas.

Personal Belongings
No personal items, valuables, or weapons should be brought to the Test Center. Only wallets and keys are permitted. Coats must be left outside the testing room. Candidates will be provided a locker to store their wallet and/or keys with them in the testing room. They will not have access to these items until after the examination is completed. Please note the following items will not be allowed in the testing room except securely locked in the locker:

- Watches

- Hats

- Wallets

- Keys

- Electronic devices

Once candidates have placed everything into the locker, they will be asked to pull out their pockets to ensure they are empty. The proctor may also ask candidates to

lift up the ends of their sleeves and the bottoms of their pant legs to ensure that notes or recording devices are not hidden there. Proctors will also carefully inspect eyeglass frames, tie tacks, or any other apparel that could be used to harbor a recording device.

If all personal items will not fit in the locker, the candidate will not be able to test. The site will not store any personal belongings. The candidate may need to return items to their vehicle.

Personal belongings include, but are not limited to, the following items:

- Electronic devices of any type, including cellular / mobile phones, recording devices, electronic watches, cameras, pagers, laptop computers, tablet computers (e.g., iPads), music players (e.g., iPods), smart watches, radios, or electronic games.

- Bulky or loose clothing or coats that could be used to conceal recording devices or notes. For security purposes outerwear such as, but not limited to open sweaters, cardigans, shawls, scarves, hoodies, vests, jackets, and coats are not permitted in the testing room. In the event a candidate is asked to remove the outerwear, appropriate attire, such as a shirt or blouse should be worn underneath.

- Hats or headgear not worn for religious reasons or as religious apparel, including hats, baseball caps, or visors.

- Other personal items, including purses, notebooks, reference or reading material, briefcases, backpacks, wallets, pens, pencils, other writing devices, food, drinks, and good luck items.

If any personal items are observed in the testing room after the examination is started, the administration may be subject to forfeiture.

Test Center Experience Video

A overview of the testing process and what to expect on your test day can be viewed at https://www.pearsonvue.com/us/en/test-takers/pearson-professional-center-tour.html.

Test Center Environment

It is unlikely that an NCCAA certification candidate will be the only person taking an examination in the examination room. Individuals taking other examinations will most likely be present. Some examinations may require full use of the computer keyboard, and there may be accompanying keyboard noise. In addition, Pearson personnel and other individuals may leave and enter the exam room during the certification candidate s exam period.

Test centers will make every effort to keep movement of personnel and noise levels to a minimum during examination administrations. However, if a certification candidate believes that noise may be a distraction, they should request earplugs at the test center to use during the Certification Exam.

In the unlikely event that the test center is unable to provide a reasonable environment for examination, the candidate should notify the test center staff, request documentation of the issue from the test center and notify NCCAA as soon as practicable.

Individual exam rooms are not available at most test centers and would require accommodation application and documentation in advance to be utilized. (See Accommodations section)

Taking the Exam

Examination Software

Prior to attempting the examination, you will be provided an exam overview with the sections and time for each section. Additionally, you will be provided a list of the key features of the examination software delivery program to familiarize yourself prior to beginning. The time you use for this process is NOT counted as part of your examination time or score. When you are comfortable with the computer testing process, you may click “Next” and begin the timed examination.

Timed Examination

Before beginning the examination, instructions for taking the examination are provided on-screen. The computer monitors the time you spend on the examination. The examination will terminate if you exceed the time allowed for the current item block or the examination. You may click on the time or the clock icon in the upper right corner of the screen to toggle the timer on and off. A digital clock indicates the time remaining for you to complete the section currently attempting.

The candidate can turn off the Time feature during the examination. However, the time for administration of the exam continues to run.

Only one examination question is presented at a time. The question number appears in the lower right portion of the screen. Choices of answers to the examination question are identified as A, B, C, or D. You must indicate your choice by either typing in the letter or clicking on the option using the mouse. To change your answer, enter a different option by typing A, B, C, or D or by clicking on the option using the mouse. You may change your answer as many times as you wish during the examination time limit.

To move to the next question, click on the "Next" (>) button in the lower right portion of the screen. This action will move you forward through the examination question by question. If you wish to review any question or questions, click the "Review" button and click on the item number you wish to review.

An examination question may be left unanswered for return later in the examination session. Questions may also be flagged for later review by clicking in the blank square below the time and item number with the label "Flag for Review" immediately to the right of the blank square. To identify all unanswered and bookmarked questions, click the button labeled "Navigator" at the bottom of the screen. Item status, flags and notes for each item in the section will appear. Click on the item number you desire to review. If not all questions have been answered and there is time remaining, return to the examination and answer those questions that do not list "Complete" as the item status. The number of unseen/incomplete items will appear in the bottom right corner of the Navigator screen.

Candidate Comments

During the examination, you may make comments for any question by clicking on the "Give Feedback" button at the bottom of the screen This opens a dialogue box where comments may be entered. Comments will be reviewed, but individual responses will not be provided. The comments will be used by the NCCAA to identify issues with items to improve exams and provide appropriate scoring of exams.

Following the Examination

After completing the examination, you are asked to answer a short evaluation of your examination experience.

If a personal emergency requires you to take a break during an examination block, an Irregularity Report will be filed. **The test center administrator will report this irregularity to the NCCAA.**

Examination Format

The Certification Examination contains 180 items divided into two (2) blocks of 90 items, with 110 minutes to complete the block of items. The examination will be administered in the following format:

- *Pre-test tutorial*: 10 - 15 minutes
- *Examination*: 235 minutes – two (2) 110-minute blocks of 90 items each, with an optional break time of a maximum of 15 minutes to be taken between the first and second examination blocks only.
- *Post-test survey*: 10 - 15 minutes

Behavior During an Exam

The candidate is not permitted to bring any personal belongings into the testing room, including but not limited to written or printed materials, mechanical or electronic devices, handbag, wallet, notes, study materials, calculator, watch, recording or filming devices, cell phone, food, or beverages.

The candidate is not permitted to communicate with, seek aid from, or provide aid to any other candidate during the examination.

During the examination, calculations may be performed by using the marker board and marker provided by the test center. An online calculator will be presented to candidates during the examination. The calculator icon can be found on the computer screen.

Test center staff monitor all testing sessions during examinations.

Test center staff are not authorized to answer questions from candidates regarding examination content, testing software, or scoring.

Restrooms are provided at the test center. A candidate may be excused from testing to use the restroom according to test center regulations.

Audio and video monitoring is employed at all test centers. Inappropriate behavior during testing may result in termination of testing. Inappropriate behavior during testing may result in the candidate's examination being declared invalid.

POST EXAM ADMINISTRATION

Behavior Following the Exam

The content of the NCCAA Certification Exam, and each individual exam item, is the property of the NCCAA and is copyrighted and protected from publication via electronic, written or other means. The retention, possession, copying, distribution, disclosure, discussion, or receipt of any NCCAA exam item, in whole or in part, by written, electronic, oral, or other form of communication, including but not limited to emailing, copying, or printing of electronic files, and reconstruction through memorization and/or dictation, before, during, or after the NCCAA Certification exam is strictly prohibited and may result in disciplinary action, assessment of monetary damages, and further legal liability. Candidates who are aware of improper behavior should report it to the NCCAA. All reasonable attempts will be made by NCCAA to maintain the report as confidential.

Issues at Test Center

Candidates will have access to a test center administrator. As a general policy, if a problem occurs with the computer and a candidate must restart their exam on the scheduled test day, the exam will be resumed at the point of interruption as the items and answers are saved to a backup continuously. However, if the exam cannot be resumed on the same day and the candidate must reschedule their exam, a new Certification Examination will be administered. There will be no charge to the candidate for rescheduling an exam if the problem was caused by circumstances at the Pearson test center.

Issues related to admission or administration of the Certification Exam, including any issues related to conditions at a Pearson test center, should be reported immediately at the test center before leaving, **and** as soon as possible, **but no later than three (3) business days after the examination**, by email to the NCCAA office at contact@nccaa.org.

Reports to the NCCAA should include the candidate s full name, test center location and address, as well as a description of the conditions that caused the issue(s) at the test center. After reviewing a report of a problem at a test center, the NCCAA may, at its discretion, determine whether a new Certification Exam should be administered, or another action should be taken. NCCAA will not consider notice of exam administration issues received more than three (3) business days after the examination date.

Examination Results

The pass/fail exam results will be uploaded to the candidate's profile within the secure NCCAA mobile app. The typical timeframe for receiving results is 6-8 weeks post examination.

Results will include an overall score and subject matter area scores for the candidate, as well as national averages for cohort comparison. This information will only be available to the candidate and the candidate's educational program. The score data is not available to employers, state medical boards and other parties as this information can be misused without proper context to attempt to distinguish among candidates.

The only information available to candidates regarding the results of the NCCAA Certification Exam will be the information provided within the official results documents from the NCCAA. Due to the need to maintain exam security, exams and exam items will not be made available for review.

Any candidate who does not receive the pass/fail exam results within 10 weeks of taking the NCCAA Certification Exam should contact the NCCAA by email at contact@nccaa.org.

Employers & Third Parties

Again, the NCCAA does not share examination results with employers or state licensing boards. Both are encouraged to verify potential employee s/licensee's certification status free of charge on the NCCAA website at: www.nccaa.org.

Verification of Examination Results

The NCCAA makes every effort possible to assure that scores awarded examinees are valid scores. When NCCAA feels that an examinee's score does not represent a

reasonable assessment of the examinee's knowledge, this irregular score may be judged invalid, neither pass nor fail. A score may be considered irregular for any one of several reasons, including, but not limited to:

- Inappropriate behavior on the part of the examinee or other examinees
- Failure to complete all required components of the examination
- Aberrations in the examination process beyond the examinee's control
- Statistical analysis indicating irregular score(s)

A score irregularity that is under investigation will not be released. Following analysis of all available information and evidence pertaining to the score irregularity, the NCCAA will make a determination as to the validity of that score.

When an investigation is initiated by the NCCAA, the examinee will be notified of that investigation. The examinee may be requested to provide written information during the NCCAA's investigation.

If the NCCAA, based upon all available information, decides that an irregularity has occurred, the score may be ruled invalid. An invalid score will not be reported. Depending upon the circumstances of the irregularity and upon the NCCAA's decision concerning validity, the NCCAA may require the examinee to be reexamined no later than the next regularly scheduled examination, may revoke certification, and may take other corrective action deemed appropriate, including denial of admission to any future examinations. The examinee will be notified of the decision and related the NCCAA determinations within 10 days following the decision. At the time of notification, the individual will receive written information pertaining to the appeal process of the NCCAA.

Because of the rigorous process ranging from pre-examination quality control and post-examination scoring, errors in scoring are virtually nonexistent. However, candidates who receive a failing score may request that their NCCAA Certification Exam results be verified. Requests for verification of results must be made in writing within three (3) months after the exam date and must include the following information: candidates name, candidate ID, exam date, exam location and signature. Exam verification fees may apply. Requests should be sent via email to contact@nccaa.org.

Re-registration Process

If a candidate fails the exam, their account will reflect registration for the next consecutive administration of the Certification Exam. Registration for each exam administration opens approximately 90 days prior to the exam date. When registration is open, the candidate will select "Certification Exam", then "Pay Now" to submit the retake fees via credit card. Once payment has been made, the candidate will use the "Testing Center" button to link to Pearson's scheduling platform, following the registration instructions listed above.

ADMINISTRATIVE ACTION AND APPEALS PROCESS

Inappropriate Behavior

Inappropriate behavior is any act or attempt to subvert the processes of application, testing, or certification as administered by the National Commission for Certification of Anesthesiologist Assistants (NCCAA). Inappropriate behavior may occur prior to, during, or following the administration of an examination. The NCCAA considers any inappropriate behavior a threat to the integrity of its examination and certification processes.

Inappropriate behavior which might occur ***prior to*** an examination includes, but is not limited to:

- Falsification of information required for application, including the application itself and supporting documents.
- Material misrepresentation of information related to the application.
- Omission of pertinent information from the application or supporting documents.
- Impersonation of another examination applicant.
- Misconduct.
- Having or attempting to obtain access to contents of an examination.

Inappropriate behavior which might occur ***during*** an examination includes, but is not limited to:

- Falsification of information required for admission to the examination.
- Impersonation of another examination candidate.
- Copying of answers from another examinee.
- Permitting one's answers to be copied by another examinee.
- Providing or receiving unauthorized information during the examination.
- Removing or copying or reproducing examination materials.
- Attempting to remove or copy or reproduce examination materials.
- Communicating or attempting to communicate with anyone except an examination proctor during testing, regardless of whether inside or outside the room in which the examination is being conducted.
- Disruptive activity during an examination.

Inappropriate behavior which might occur ***following*** an examination includes, but is not limited to:

- Altering or misrepresenting an NCCAA document (e.g., examination score report, certificate, or other official information reported by the NCCAA).
- Reproducing or attempting to reproduce examination materials.
- Misconduct, including any act or attempt to disrupt NCCAA's certification process.
- Counterfeiting NCCAA examination score reports, certificates, or other official documents not only represents inappropriate behavior but also will result in legal action being taken.

Anyone who has information or evidence that any inappropriate behavior might have occurred should submit a written report to the NCCAA providing a detailed description of the inappropriate behavior, including copies of any supporting documentation or other evidence. In so far as possible, such written reports will be treated as confidential. Proctors at a test site may receive reports of inappropriate behavior at any time during testing.

The NCCAA may take the following actions for inappropriate behavior discovered prior to or during an examination:

- Loss of current examination eligibility
- Loss of future examination eligibility

The NCCAA may take the following actions for inappropriate behavior discovered after an examination has been completed but before examination results are reported:

- Loss of future examination eligibility
- Withholding of examination score
- Withholding of certification

The NCCAA may take the following actions for inappropriate behavior discovered subsequent to certification:

- Loss of future examination eligibility
- Recalling of examination scores
- Revocation of certification

Depending upon the severity and scope of a candidate's inappropriate behavior, the NCCAA may take appropriate legal action.

In each case where the NCCAA takes action on the basis of inappropriate behavior, the individual(s) involved will be notified of the evidence and of the action being taken. The individual(s) will be informed of the NCCAA appeal process in the same communication. If for reasons of inappropriate behavior, an application is denied, scores are invalidated, or certification is revoked, the NCCAA reserves the right to notify other agencies who have legitimate interests. Possible notified agencies include, but are not limited to, the Federation of State Medical Boards of the United States; individual state licensing boards; current and potential employers; educational programs; other agencies that make decisions about the individual based, at least in part, upon examination scores or the NCCAA certification process.

By making application for a Certifying Examination or a CDQ Examination, an applicant fully and unconditionally consents to disclosure by the NCCAA as described above.

Administrative Action

Pursuant to NCCAA Policies & Procedures for Discipline, Administrative Action and Appeals (collectively known as *NCCAA Policies*"), Certified Anesthesiologist Assistants (CAAs), examinees, and applicants for Certification, Recertification or Continued Certification (collectively known as certification") are subject to administrative action for engaging in conduct regarded by the NCCAA as inconsistent with unrestricted recertification. The *NCCAA Policies* set forth the conduct that can lead to sanctions, the procedures that will govern, the administrative actions that may be imposed and the right of appeal for those in receipt of an administrative action. The *NCCAA Policies* can be found on the NCCAA website at www.nccaa.org, or within the NCCAA mobile app.