

Certified registered nurse anesthetist and anesthesiologist assistant education programs in the United States

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ABSTRACT

In Japan, a relative shortage of practicing anesthesiologists continues to be a national issue. To address this issue, some Japanese medical institutions have started developing curriculums to train non-physician perioperative anesthesia personnel, including nurse practitioners and perianesthesia nurses. We urgently need to establish a national standard for the education programs that train these extended non-physician anesthesia care providers. A certified registered nurse anesthetist educational program at a large academic medical center in the United States is described in detail as a reference. Highly systematic educational programs using simulation, didactics, and full clinical subspecialty rotations are ideal if not easily achievable in many current training institutions in Japan. Anesthesia assistant education programs in the United States can be used as an additional reference to create a national educational program in Japan.

Keywords: anesthetists, education, nurse, program

Abbreviations:

CRNAs: certified registered nurse anesthetists

AAs: anesthesiologist assistants

NBCRNA: National Board of Certification and Recertification for Nurse Anesthetists

UPMC: University of Pittsburgh Medical Center

COA: Council on Accreditation of Nurse Anesthesia Educational Programs

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INTRODUCTION

In Japan, a relative shortage of practicing anesthesiologists continues to be a national issue. The number of physician anesthesia providers in Japan reported by the World Federation of Societies of Anesthesiology (2019) is 12,208, or 9.64 per 100,000. This sharply contrasts with the 67,000 physicians or 20.82 per 100,000 giving anesthesia in the US. Other than physicians, 57,000 nurse anesthetists provide anesthesia care in the US. Certified registered nurse anesthetists

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(CRNAs) and anesthesiologist assistants (AAs) perform tasks under physician anesthesiologists' supervision. In some areas in the US, CRNAs can provide anesthesia independently; for instance, most anesthetics in rural areas are provided by nurse anesthetists.

In Japan, the shortage of anesthesia providers often results in the cancellation of scheduled surgeries and prolonged working hours for anesthesiologists. In recent years, with advances in medical care and technology, the average human life expectancy (currently 84.2 years) has been gradually increasing.¹ Also, the number of surgeries is progressively growing due to the expansion of various new operations and surgical indications. In addition to providing surgical anesthesia, anesthesiologists' range of activities is expected to be further broadened by expanding the field of anesthesia to focus on ensuring the safety and security of patients. This widened range of activities includes preoperative outpatient care, postoperative pain management, and sedation outside the operating room. In Japan, there are instances when surgeons have to manage the anesthesia care of their surgical patients themselves due to the shortage of anesthesiologists. Hospitals often have to hire *locum tenens* anesthesiologists to meet the demand for surgical cases. These conditions are certainly not ideal for the safety of surgical patients and the stability of hospital finances.

To address this issue, five Japanese medical institutions have started developing curriculums to train non-physician perioperative anesthesia personnel, including nurse practitioners and perianesthesia nurses.^{2,3} National standards for nurse anesthetist and anesthesiology assistant education programs need to be developed in Japan to provide consistent and safe anesthesia care.

We describe herein CRNA and AA educational programs⁴ at a large academic medical center in the US as references.

Certified Registered Nurse Anesthetists

The discipline of nurse anesthesia was developed in the late 1800s. Sister Mary Bernard was the first nurse to specialize in nurse anesthesia at St. Vincent Hospital in Erie, Pennsylvania, in 1877.⁵ As few physicians focused their attention on anesthesia, nurse anesthetists learned anesthesia from surgeons and their own experiences. During World War I, they performed anesthesia for many wounded patients. The first formal nurse anesthesia educational program was established at St. Vincent Hospital (Erie, Pennsylvania, USA) in 1909. The title "certified registered nurse anesthetist (CRNA)" was first introduced in 1956. CRNAs can perform tasks under the supervision of physicians as well as independently depending on State regulations. The National Board of Certification and Recertification for Nurse Anesthetists (NBCRNA) administers the certification examination for nurse anesthetist trainees. The University of Pittsburgh School of Nursing Nurse Anesthesia Program partners to offer the program with the University of Pittsburgh Medical Center (UPMC). The current nurse anesthesia program's foundations can be traced to the individual training programs in the late 1950s at Presbyterian and Montefiore University Hospitals in Pittsburgh. These two hospital programs merged in 1972, and the Nurse Anesthesia Program is now in the Department of Nurse Anesthesia at the University of Pittsburgh School of Nursing. Fortunately, the University of Pittsburgh Nurse Anesthesia Program was ranked #4 in the US News & World Report rankings of Best Nursing Graduate Program since 2016, with the overall Doctor of Nursing Practice program ranking #9 in the United States in 2019.⁶ The University of Pittsburgh Nurse Anesthesia Program has been ranked in the top 10 by US News & World Report since 1998.

The Mission of the University of Pittsburgh Nurse Anesthesia Program

The primary purpose of the Nurse Anesthesia Program in the University of Pittsburgh School of Nursing is to educate registered nurses in both the science and art of anesthesia so that

they will become efficient and skilled in utilizing various techniques of anesthesia intelligently, scientifically, and safely (Table 1). In addition to practicing skills, graduates gain research and scholarship skills that provide a foundation for future work as doctorally prepared Nurse Anesthetists. The program's graduate standards are shown in Table 2.

Table 1 Program Mission

1. Offer a superior graduate nurse anesthesia educational program
2. Respond to the needs of the community and the patients for whom our students provide anesthesia nursing care
3. Engage in research activities throughout the nurse anesthesia program curriculum with the intent to strengthen understanding of the evidence base for anesthesia practice
4. Engage in scholarly activities throughout the nurse anesthesia program curriculum with the intent to extend frontiers of knowledge in anesthesia

Table 2 Graduate Standards for the University of Pittsburgh Nurse Anesthesia BSN to DNP Program

Patient safety - the graduate must demonstrate the ability to:

1. Be vigilant in the delivery of patient care
2. Refrain from engaging in extraneous activities that abandon or minimize vigilance while providing direct patient care
3. Conduct a comprehensive equipment check
4. Protect patients from iatrogenic complications

Perianesthesia - the graduate must demonstrate the ability to:

1. Provide individualized care throughout the perianesthesia continuum
2. Deliver culturally competent perianesthesia care
3. Provide anesthesia service to all patients across the lifespan
4. Perform a comprehensive history and physical assessment
5. Administer general anesthesia to patients with a variety of physical conditions
6. Administer general anesthesia for a variety of surgical and medically-related procedures
7. Administer and manage a variety of regional anesthetics
8. Maintain current certification in ACLS and PALS

Critical thinking - the graduate must demonstrate the ability to:

1. Apply knowledge to practice in decision making and problem solving
2. Provide nurse anesthesia services based on evidence-based principles
3. Perform a preanesthetic assessment before providing anesthesia services
4. Assume responsibility and accountability for diagnosis
5. Formulate an anesthesia plan of care before providing anesthesia services
6. Identify and take appropriate action when confronted with anesthetic equipment-related malfunctions
7. Interpret and utilize data obtained from noninvasive and invasive monitoring modalities
8. Calculate, initiate, and manage fluid and blood component therapy
9. Recognize, evaluate, and manage the physiological responses coincident to the provision of anesthesia services

10. Recognize and appropriately manage complications that occur during the provision of anesthesia services
11. Use science-based theories and concepts to analyze new practice approaches
12. Pass the national certification examination administered by the National Board of Certification and Recertification for Nurse Anesthetists

Communication - the graduate must demonstrate the ability to:

1. Utilize interpersonal and communication skills that result in the effective exchange of information and collaboration with patients and their families
2. Utilize interpersonal and communication skills that result in the effective interprofessional exchange of information and collaboration with other healthcare professionals
3. Respect the dignity and privacy of patients while maintaining confidentiality in the delivery of interprofessional care
4. Maintain comprehensive, timely, accurate, and legible healthcare records
5. Transfer the responsibility for care of patients to other qualified providers in a manner that assures continuity of care and patient safety
6. Teach others

Leadership - the graduate must demonstrate the ability to:

1. Integrate critical and reflective thinking in his or her leadership approach
2. Provide leadership that facilitates intraprofessional and interprofessional collaboration

Professional role - the graduate must demonstrate the ability to:

1. Adhere to the code of ethics for the certified registered nurse anesthetist
 2. Interact on a professional level with integrity
 3. Apply ethically sound decision-making processes
 4. Function within legal and regulatory requirements
 5. Accept responsibility and accountability for his or her practice
 6. Provide anesthesia services to patients in a cost-effective manner
 7. Demonstrate knowledge of wellness and substance use disorder in the anesthesia profession through completion of content in wellness and substance use disorder
 8. Inform the public of the role and practice of the CRNA
 9. Evaluate how public policy-making strategies impact the financing and delivery of healthcare
 10. Advocate for health policy change to improve patient care
 11. Advocate for health policy change to advance the specialty of nurse anesthesia
 12. Analyze strategies to improve patient outcomes and quality of care
 13. Analyze health outcomes in a variety of populations
 14. Analyze health outcomes in a variety of clinical settings
 15. Analyze health outcomes in a variety of systems
 16. Disseminate research evidence
 17. Use information system/technology to support and improve patient care
 18. Use information system/technology to support and improve healthcare systems
 19. Analyze business practices encountered in nurse anesthesia delivery settings
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Nurse Anesthesia Program Curriculum at the University of Pittsburgh School of Nursing

Nurse anesthesia practice covers the continuum of care from preoperative assessment to discharge from the post-anesthesia care unit. Nurse anesthetists interview and assess each patient

to best formulate and implement an individualized plan of care while collaborating with members of a multi-disciplinary health care team. The rigorous curriculum features courses addressing the chemistry and physics of anesthesia, evidence-based practice, advanced pharmacology, and professional role development. The curriculum also emphasizes simulation education, with the average student experiencing more than 120 hours of simulation coursework. The three-year plan is shown in Online Supplementary Table 1. By the end of the program, students manage a minimum of 800 anesthesia cases and document more than 2,000 clinical hours. The nurse anesthesia program curriculum is offered in a full-time format over 36 months (nine terms), and classes begin each January. The curriculum comprises 86 credits (course and clinical). One credit is equivalent to one hour of classroom time and a minimum of four hours of clinical instruction each week, or 15 hours of lecture and a minimum of 60 hours of clinical instruction for a 15-week semester. On average, each student completes more than 40 hours of clinical each week during the program. After the first two terms, the curriculum design integrates classroom, simulation, and clinical experiences. The curriculum comprises 39 core credits and 47 anesthesia specialty credits. The clinical experience required for graduation is shown in Table 3.

Table 3 Clinical experiences required to submit an application for the CRNA National Certification Examination (Council on Accreditation of Nurse Anesthesia Educational Programs Appendix)

Patient Physical Status	Minimum Required Cases	Preferred Number of Cases
Class I	as appropriate	as appropriate
Class II	as appropriate	as appropriate
Class III–VI (total of a, b, c & d)	200	300
a. Class III	50	100
b. Class IV	10	100
c. Class IV	0	5
d. Class IV	as appropriate	as appropriate
	Total cases	600
		700
Special cases		
Geriatric 65+ years	100	200
Pediatric		
Pediatric 2 to 12 years	30	75
Pediatric (less than 2 years)	10	25
Neonate (less than 4 weeks)	as appropriate	5
Trauma/emergency	30	50
Obstetrical management (total of a & b)	30	40
a. Cesarean delivery	10	15
b. Analgesia for labor	10	15
Pain management encounters	15	50
Anatomical Categories		
Intra-abdominal	75	
Intracranial (total of a & b)	5	20
a. Open	3	10
b. Closed		

Oropharyngeal	20	
Intrathoracic (total of a, b, & c)	15	40
a. Heart		
1. Open heart cases (total of a & b)	5	10
a. With cardiopulmonary bypass		
b. Without cardiopulmonary bypass		
2. Closed heart cases		10
b. Lung	5	
c. Other		
Neck	5	10
Neuroskeletal	20	
Vascular	10	30
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Methods of Anesthesia		
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General anesthesia	400	
Inhalation induction	25	40
Mask management	25	35
Supraglottic airway devices (total of a & b)	35	50
a. Laryngeal mask		
b. Other		
Tracheal intubation (total of a & b)	250	
a. Oral		
b. Nasal		5
Alternative tracheal intubation/endoscopic techniques (total of a & b)	25	50
a. Endoscopic techniques (total of 1 & 2)	5	15
1. Actual tracheal tube placement		
2. Simulated tracheal tube placement		
3. Airway assessment		
b. Other techniques	5	25
Emergence from anesthesia	300	
Regional techniques		
Actual administration (total of a, b, c, & d)	35	
a. Spinal (total of 1 & 2)	10	50
1. Anesthesia		
2. Pain management		
b. Epidural (total of 1 & 2)	10	50
1. Anesthesia		
2. Pain management		
c. Peripheral (total of 1 & 2)	10	50
1. Anesthesia		
Upper		
Lower		
2. Pain management		

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Upper		
Lower		
d. Other (total of 1 & 2)		
1. Anesthesia		
2. Pain management		
Management (total of 1 & 2)	35	50
1. Anesthesia		
2. Pain management		
Moderate/deep sedation	25	50
Arterial Technique		
Arterial puncture/catheter insertion	25	
Intra-arterial blood pressure monitoring	30	
Central Venous Catheter		
Placement – Non-PICC (total of a & b)	10	15
a. Actual		5
b. Simulated		
Placement – PICC (total of a & b)	as appropriate	as appropriate
a. Actual		
b. Simulated		
Monitoring	15	
Pulmonary Artery Catheter		
Placement		5
Monitoring		10
Other		
Ultrasound-guided techniques (total of a & b)		10
a. Regional		
b. Vascular		
Intravenous catheter placement	100	
Advanced noninvasive hemodynamic monitoring	as appropriate	as appropriate

Nurse anesthesia programs in the United States are accredited by the Council on Accreditation of Nurse Anesthesia Educational Programs (COA) which is recognized by the United States Department of Education (USDE). A self-study document is provided to the COA before two reviewers visit each site to evaluate compliance with the Standards for Accreditation of Nurse Anesthesia Programs (2019). This document defines standards for faculty qualifications, students, resources, teaching, curriculum, clinical instruction, and evaluation processes conducted by nurse anesthesia programs. Reviewers from the COA meet with students, faculty, and staff at clinical sites teaching students in the program. The frequency of accreditation visits depends upon recommendations from the site's prior accreditation visit.

Students that have completed the curriculum take the National Certification Examination provided by the NBCRNA. Passing the exam provides the student with the CRNA credential required for practice as a nurse anesthetist in the US. Some states also require nurse anesthetists to provide documentation of specific clinical and didactic coursework and pay an additional fee to be licensed as advanced practice registered nurses (APRNs).

Finally, necessary expenses and acceptance rate are described. Students are required to attain a final course grade of at least 80% in each course that they take. This course pass threshold is established at the University and School levels and is consistent with doctoral programs across the United States. The probability of passing the overall course of study in the Pitt Nurse Anesthesia Program once admitted is has averaged 95% over the last two decades. The probability of passing the National Certification Examination for Nurse Anesthetists on the first attempt nationally on the first attempt over the past five years is 84.1%. The National Certification Examination is administered by the NBCRNA. The performance of the University of Pittsburgh Program has historically been better than this. The required tuition is currently about \$104,000 (for Pennsylvania resident), or about \$124,000 (for non- Pennsylvania resident) for the entire 36 month curriculum.

Anesthesiologist Assistant (AA)

The AA's role is designed to support anesthesia care under the direct supervision of anesthesiologists. Their responsibilities are similar to those of CRNAs. However, AAs work only under the direct supervision of anesthesiologists in the anesthesia care team's environment. The AA profession was conceived in the 1960s by three university anesthesiology department chairs in response to a shortage of physician anesthesiologists.⁷ In 1969, the first AA training program began accepting students at Emory University in Atlanta, Georgia, while a second program was started at Case Western Reserve University in Cleveland, Ohio. Currently, there are 18 AA schools, and applicants must have a bachelor's degree. Each state determines the places where AAs can work; AA education programs have expanded to 18 states (Alabama, Colorado, District of Columbia, Florida, Georgia, Kentucky, Michigan, Missouri, New Hampshire, New Mexico, North Carolina, Oklahoma, Ohio, South Carolina, Texas, Vermont, West Virginia, and Wisconsin). AAs train for their profession through a different route than CRNAs. Nursing licensure and healthcare experience are not mandatory. Many AAs have a pre-medical background and have completed a comprehensive educational and clinical program at the graduate level. They can receive a degree through a 24–28-month program. The curriculum and graduation requirements are like those of CRNAs discussed above. AAs must pass a certification examination administered by the National Commission for Certification of Anesthesiologist Assistants in collaboration with the National Board of Medical Examiners.

Differences exist between AA and CRNA education programs regarding prerequisites, actual conditions for supervision, and accreditation maintenance. These differences exist because the two professions were developed through different paths. High school graduates are directly admitted to four-year, full-time pre-licensure baccalaureate nursing programs; they are educated to become professional nurses whose practice is based upon nursing and related sciences. Graduates of the program are professional nurses with the necessary base for graduate education and continuing professional development. All nurse anesthesia programs require applicants to have at least one year of full-time experience as ICU nurses. Nurse Anesthesia educational programs require an additional three years of full-time study and then completion of the National Certification Examination.

AA program applicants generally present with a background of science-related studies, and a baccalaureate degree from an accredited college or university in the US or Canada. All applicants will need to have completed the core requirements for application to most US medical schools, although any degree is accepted. Thus, neither the AA nor the CRNA certification can be obtained only through four years of university education, and the prerequisites and pathways for obtaining each certification differ. According to the most current statistics, the mean total yearly compensation for a full-time CRNA in the US is over \$170,000 compared to the average

AA annual salary of around \$100,000 in the US. There are similar responsibilities on the face of it, and they often both work in anesthesia teams with anesthesiologists. However, they have different educational pathways and accreditation bodies. CRNAs have prior experience as critical care nurses and can work without direct anesthesiologist supervision, allowing them to take call and provide services in consultation with physicians, including the surgeon. Some CRNAs appear to oppose the spread of AA programs, and some physicians have supported AAs as CRNA replacements (Table 4).

Table 4 Differences between certified registered nurse anesthetists (CRNAs) and anesthesiologist assistants (AAs)

	CRNAs	AAs
Scope of Practice	Can practice in all 50 states and every US territory Licensed Independent Practitioners in US Military (LIP) # Preoperative evaluation # General Anesthesia # Neuraxial anesthesia # Regional anesthesia # Pain management # Postop management # Intravascular access	Can practice in 18 states
Supervision	# During COVID-19, the Centers for Medicare and Medicaid Services suspended supervision requirements for CRNAs # Opt out in 18 states requiring no supervision # Medical supervision # Medical direction	Supervision by anesthesiologist
Income	Mean total annual compensation for full-time CRNAs is over \$170,000 in the US	Average annual AA salary is around \$100,000 in the US
Practice sites	# Hospitals # Same day surgery centers # Offices of dentists, podiatrists, ophthalmologists, and plastic surgeons # Pain clinics # Critical access hospitals	

Reflection on the Current Perioperative Nurse Anesthetist Educational System in Japan

Although it is challenging to create new national certifications such as CRNA in Japan, it is expected that comprehensive anesthesia management opportunities will increase in the future, with nurse practitioners and perioperative nurses playing a role. To widely spread the anesthesia nurse practitioner in Japan, the following three matters become the main points considering Japanese law and the present medical system.

First, in Japan, creating a unified certification for anesthesia nurse practitioners to ensure these professionals' skills and care quality is ideal. The number of facilities that train perioperative

anesthesia nurses or practitioners is increasing in Japan. However, there are several certification bodies and certification names. Furthermore, in some cases, the qualification can only be used at a qualification facility. By creating a unified qualification in Japan, these certified anesthesia nurse practitioners would be able to relocate to institutions without concern regarding losing privileges. Also, nurses can expand the field of hospital activities, including a shorter workday style and part-time work.

Second, current educational programs for anesthesia nurse practitioners in Japan overwhelmingly lack in their vigor in simulation and clinical training compared to those in the US. One solution would be to increase anesthesia nurse practitioners' opportunities to learn alongside anesthesiologists in simulation education and clinical training.

Third, currently, there is little financial incentive to become an anesthesia nurse practitioner in Japan. It does not demand a standard wage like the United States. The incentive for working day as an anesthesia nurse practitioner may be easy to introduce early. It is reasonable for these highly-trained anesthesia nurse practitioners to receive better wages than those of nurse practitioners. The institutions may be financially well-off and continue to provide high quality care by hiring these anesthesia nurse practitioners instead of relying on locum anesthesiologists' anesthesia care. With the development of anesthesia nurses, anesthesiologists and surgeons will perform more operations, and the development of acute-phase medical care, including surgery, will lead directly to management development for hospitals. Improving incentives for surgeons and anesthesiologists has been controversial for some time, but there is no sign of progress. The government or each hospital is entering a period that requires establishing an incentive system for the individual for perioperative management, including surgeons, anesthesiologists, and anesthesia nurse practitioners in Japan.

Advocacy by anesthesiologists, surgeons, existing nurses, and hospitals is necessary to create a unified approval for anesthesia nurse practitioners in Japan, and it is impossible to implement it immediately. If an educational institution such as ours takes the lead, we believe that advocacy as a hospital will be born and that discussions on the unification of approval will deepen.

Responsibility

In the current situation in Japanese law, anesthesia nurse practitioner practice under the supervision of anesthesiologists. However, it should not be forgotten that responsibility is involved. For reference, the responsibilities of anesthesiologists in the United States are described below. Whether it is an anesthesiologist or the surgeon, having physician supervision does not provide full protection for the CRNA. There is only one state in the US where an anesthesiologist's supervision is required (New Jersey). In every other state requiring supervision, a physician can be the anesthesiologist or a surgeon. This is true in Pennsylvania, and there are many CRNA practices with this model. Each practitioner is independently responsible for their actions, and if they deviate from a plan of care or the standard of care, they are potentially liable. Typically, the CRNA and MD are named in a suit, and damages are awarded according to the jury or judge's responsibility assignment.

CONCLUSION

Establishing educational standards for perioperative nurse anesthetists and including these professionals as integral members of anesthesia management teams should be the strategy to address the national shortage of anesthesiologists in Japan. Understanding the content of CRNA and AA educational programs in the US is essential for discussing strategies to determine the

best method to train those extended anesthesia care providers in Japan. It is vital to determine educational standards for anesthesia nurse practitioners, who would better meet the current need for additional anesthesia care providers in Japan. It is also necessary to establish a unified certification process with which anesthesia nurse practitioners would be able to mobilize their skills in the county.

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DISCLOSURE STATEMENT

None of the authors has any conflicts of interest to declare about this work.

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Appendix: Supplementary data**Supplementary Table 1** Three-year full-time curriculum plan

YEAR 1, TERM 1 (SPRING)	Credits
<p>Introduction to the Nurse Anesthesia Role This introductory course will provide student socialization into the role of nurse anesthesia practice and prepares the student for more advanced content within the curriculum. This course provides fundamental concepts related to the professional role, anesthesia types, and anesthesia processes. Safety principles essential to preventing negative outcomes for both patients and providers will be emphasized.</p>	1.5
<p>Applied Statistics for Evidence-based Practice This course will provide students with the basic for understanding and interpreting commonly used statistical tests, as well as critically appraising their use in published research studies. Content will include descriptive and inferential statistics commonly reported in published research studies including both univariate and multivariate parametric and nonparametric tests. The course will also cover meta-analytic techniques and students will learn to calculate effect sizes.</p>	3.0
<p>The Science of Health Care Delivery This course is designed to develop a theoretical, practical, and evidence-based foundation for the delivery of safe, effective, evidence-based health care. Participants in this course will develop the knowledge base and critical thinking skills central to identifying and solving problems in the planning, implementation, and evaluation of health care across the continuum of care delivery systems and across professions. The two overarching goals of the course are to a) develop a better understanding of how the healthcare delivery system works and fails to work, and b) develop a foundation for organizational and systems leadership for care reform, quality improvement, and systems thinking in the delivery of safe, effective, evidence-based care using interprofessional approaches.</p>	2.0
<p>Pathophysiology Across the Life Span This course is designed to provide the student with a comprehensive theoretical foundation of the phenomena that produce alterations in human physiologic function in diverse populations across the life span. Information gained in this course will prepare the student for a subsequent course related to the diagnosis and management of disease processes associated with pathophysiologic dysfunction/alterations in people of various ethnic/cultural groups across the life span.</p>	4.0
<p>Introduction to Genetics and Molecular Therapeutics This introductory course focuses on the fundamentals of human and molecular genetics. It is designed to give students a basic understanding of genetic concepts and molecular techniques so that this knowledge can be applied to current and future genetic diagnoses and therapies encountered in nursing.</p>	3.0
<p>Nursing Graduate Orientation Module This module provides a web-based graduate nursing orientation that is designed to provide graduate nursing students with an overview of the School of Nursing and information that they will need to successfully complete their programs and achieve their career goals.</p>	0.0
Term total	13.5
YEAR 1, TERM 2 (SUMMER)	
<p>Advanced Pharmacology This is a basic science course covering the principles of drug action for several important classes of drugs. A basic knowledge of the principles of chemistry and biochemistry will be helpful in understanding the chemical basis of drug receptor interactions. The course begins with fundamentals of pharmacodynamics and pharmacokinetics and then covers the pharmacology of the central nervous, respiratory, gastrointestinal, renal/cardiovascular, and endocrine systems; immunosuppression; antibiotics; and antifungals.</p>	3.0

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Research for Evidence-based Practice 1	2.0
This course examines the interaction between theory, research, and clinical expertise in the development of evidence-based nursing practice. Students develop the skills needed to identify relevant research and to critically appraise published studies to evaluate their quality and applicability to clinical practice. Students gain an understanding of the research process, the critical appraisal of published research that use a variety of research designs, and the role of research in evidence-based practice.	
The Diagnostic Physical Exam Across the Life Span	3.0
This didactic course focuses on the use of the diagnostic history and physical examination to formulate a health assessment in patient populations across the lifespan. Concentration is on selected theories, principles, and techniques from the physical and behavioral sciences essential to obtaining a complete health history and performing methodical physical examination on patients across the lifespan.	
Ethics in Healthcare	1.0
Philosophical and clinical foundations in ethics are analyzed and used to provide a basis for guidelines in ethical decision-making and practice. Content will include legal-ethical issues in practice; ethical implications in the role of the doctorally-prepared nurse; historical and political influences on ethics in health care; diversity in race, gender, and sexual orientation; and principals of justice, autonomy, and provider-patient relations. Additionally, this course describes general ethical practices and ethical principles associated with the proper conduct of research, scientific integrity, and protection of human subjects.	
Methodologies for DNP Projects	2.0
During this course, students develop a proposal appropriate for a Doctor of Nursing Practice (DNP) project. The evidence-based proposal includes the following components: a) a focus on a change that directly or indirectly affects health care outcomes, b) a focus on a system or population/aggregator, c) an implementation plan in an arena or area of practice, d) a plan for sustainability, and e) an evaluation plan that measures processes and/or outcomes (formative or summative). During this course, students learn to apply the following four methodologies for the development and conduct of a DNP project and future scholarly projects: quality improvement, surveillance, program evaluation, and N of 1.	
Term total	11.0
YEAR 1, TERM 3 (FALL)	
Basic Principles of Anesthesia	3.0
This course prepares the student for entry into the clinical practice setting by presenting fundamental concepts of general, regional, pain management, and sedation anesthesia. Airway management techniques, positioning, and an introduction to anesthetic pharmacology are emphasized. Anesthetic management strategies for patients with common diseases and perioperative problems are examined.	
Basic Principles of Anesthesia (Lab)	1.0
The course provides students with necessary skills to enter clinical practice. Psychomotor, critical thinking, and affective skills will be developed using a variety of experiential learning approaches. Best practices in simulation educational methods will be used and will include a variety of approaches. Student will demonstrate attainment of entry level skills required for clinical practice.	
Chemistry and Physics in Anesthesia	2.0
This course provides the nurse anesthesia student with a fundamental understanding of chemical, biochemical, and physics principles as they relate to physiology, pharmacology, and the practice of anesthesia. Essential concepts related to chemistry and physics principles necessary to provide safe and effective anesthesia care are emphasized. Chemistry and physics concepts will be related to anesthesia equipment and processes in order to illustrate their importance to practice.	

Physical Diagnosis - Anesthesia	1.0
<p>This course offers students the skills requires for conducting a preoperative anesthesia history and physical exam, identifying risk factors (anesthetic, patient, surgical), developing a relevant anesthetic management plan, and writing appropriate post-operative orders. Students will gain skill in interpreting pre-operative diagnostic tests and lab values. Students will gain familiarity with electronic medical records and charting skills. Students in this course will also develop in the areas of educational approaches utilizing standardized patients and structured debriefing methods.</p>	
Database Management	2.0
<p>This course provides students with the conceptual knowledge base and practice experiences necessary to understand the workings of a modern relational database management system. It will provide students with the historical and practical knowledge needed to design a relational database. The students will have hands-on experiences with databases and other software that will interface with databases. Standards, such as HTML, SQL, ODBC, and normalization will be stressed in both the theory and practical aspects of this course. The future of database design and access from non-traditional environments will be discussed. Use of databases on servers will be demonstrated.</p>	
Basic Clinical Care 1	1.0
<p>Introduction to technology, monitoring, and practice (two days/week). This initial clinical course is designed to integrate with basic didactic coursework. Student will be assigned to affiliated clinical sites and anesthesia-related specialty areas. Students will be introduced to basic level anesthesia technology and equipment medications, monitoring procedures, and the perioperative environment. Experiences will begin with simple cases and techniques and build to more complex ones. Clinical experiences will be with certified registered nurse anesthetists (CRNAs) and/or anesthesiologists. Clinical case conferences and ongoing assessments will be conducted to evaluate the students' ability to apply basic didactic coursework into clinical anesthesia care.</p>	
Term total	10.0
First year total	34.5
YEAR 2, TERM 4 (SPRING)	
Health Promotion	3.0
<p>Health promotion and disease prevention are examined from theoretical foundations to clinical applications. The course focuses on individual and community health promotion assessment, screening, and interventions in diverse populations. Epidemiological principles and real clinical examples are discussed as a basis for focusing on health promotion assessment and interventions. Course topics are delineated according to Healthy People 2010 goals with a corresponding focus on factors related to health care disparities among vulnerable populations. Current research in health promotion and disease prevention is the basis for identifying appropriate interventions in diverse populations and settings.</p>	
Data Analysis for DNP Projects	2.0
<p>This course provides students hands-on experience with the menu-driven statistical software program of Statistical Package for the Social Sciences (SPSS). Content includes commonly used descriptive and inferential statistics including univariate and multivariate tests, parametric and non-parametric tests, and qualitative description. Students can analyze and interpret quantitative and qualitative data from their own DNP project dataset or an instructor-provided dataset.</p>	
Advanced Principles of Anatomy, Physiology, and Pathophysiology 1	3.0
<p>This first course in a two-course series is designed to help students' understanding of advanced concepts in anatomy, physiology, and pathophysiology related to anesthesia care. Advanced principles of patient management supported by best evidence will be applied to the clinical practice of nurse anesthesia across a variety of body systems and surgical procedures. Students will formulate and evaluate approaches to anesthesia management in the presence of pathophysiologic conditions affecting the central nervous, neuromuscular, cardiovascular, respiratory, skeletal, and immune systems.</p>	

Team Training and Patient Safety	1.0
<p>This course is designed to provide the student with a theoretical and practical foundation relating to human factors, crew resource management, and team performance issues that impact patient safety. Information and skills gained in this course will prepare the student to function as a patient advocate in a multidisciplinary environment and implement team-based strategies designed to promote patient safety. Crisis management protocols and communication algorithms e.g., situation-background-assessment-recommendation (SBAR) will be used as examples.</p>	
Basic Clinical Care 2	1.5
<p>Basic preoperative, intraoperative, and postoperative care (three days/week). This second clinical course promotes development of skills and integrates prior basic didactic content with more advanced concepts. The primary focus will be the application of physiology and pathophysiology into anesthetic practice. Students will be assigned to affiliated clinical sites and anesthesia-related specialty areas as well as increasingly complicated cases. Clinical experiences will be guided by CRNAs and anesthesiologists. Clinical case conferences will be conducted to assess the students' ability to combine more advanced didactic content into patient-specific perioperative anesthesia care.</p>	
Term total	10.5
YEAR 2, TERM 5 (SUMMER)	
Advanced Principles of Anesthesia 1	3.0
<p>This course is the first in the three-part advanced principles series which provides in-depth study of specialized areas of nurse anesthesia practice. Lectures will concentrate on the theoretical basis for specific anesthesia nursing interventions and the rationale for their use in the pediatric and obstetric specialties. Concepts related to regional anesthesia, acute pain management, and chronic pain management will be reviewed. Plans of care for pediatric, obstetric, regional anesthesia, and pain patients will be developed and evaluated. Current techniques and technologies related to the management of regional anesthesia and pain blocks will be reviewed and reinforced with a variety of simulation experiences (hands-on, screen based, virtual).</p>	
Advanced Principles of Anatomy, Physiology, and Pathophysiology 2	2.0
<p>This second course in the series is designed to review the relevant anatomy and physiology of the endocrine, renal, hepatic, gastrointestinal, other intraabdominal organ, immune, hematologic, and genitourinary systems. Students will develop an in-depth understanding of how pathophysiology involving these systems will influence anesthetic choices and management approaches. Referencing best-evidence and clinical protocols, students will derive management approaches for surgical and therapeutic procedures related to these systems. Additionally, the pathophysiology of psychiatric illness, infectious disease, cancer, and obesity will be reviewed and approaches to anesthesia care in the presence of these conditions will be developed.</p>	
Advanced Pharmacology for Nurse Anesthetists	3.0
<p>This course provides the basis for in-depth understanding of the pharmacology of clinical anesthesia practice. Specific properties of anesthetic agents and commonly used adjunctive drugs are discussed and evaluated for appropriate application in clinical situations. Development of a comprehensive knowledge base with respect to drugs used by the nurse anesthetist in the clinical setting will be achieved through lectures, presentations, situational examples, and case analyses. Students will formulate specific pharmacologic plans through synthesis of a variety of concepts.</p>	

Advanced Clinical Care 1	1.5
<p>Pain management, ultrasound, regional anesthesia, pediatrics, and obstetrics. This third clinical course is designed to begin integrating more advanced clinical concepts into the clinical experience. Primary focus will be on application of the principles of advanced physiology, pathophysiology, and applied pharmacology to management of increasingly advanced clinical cases. Students will be assigned to affiliated clinical sites and anesthesia-related specialty areas. Clinical experiences will be guided by CRNAs and anesthesiologists. Supplemental clinical case conferences will focus on the students' ability to integrate more advanced didactic content into patient-specific clinical anesthetic care. Particular emphasis will be placed on discussion of approaches to pain management, regional anesthesia, obstetrics, and pediatrics.</p>	
Term total	9.5
YEAR 2, TERM 6 (FALL)	
Advanced Principles of Anesthesia 2	3.0
Continuation of Advanced Principles of Anesthesia 1	
Organizational and Management Theory	3.0
<p>This graduate level course focuses on organizational, leadership, and management theories and how they apply to health service organizations, both today and in the future. Emphasis will be placed on leading the clinical discipline of nursing based on organizational and systems thinking, as well as relevant political and cultural perspectives. Quality and performance improvement strategies, as well as creating and sustaining appropriate levels of change, are explored in order to facilitate the ability to create safe and effective care delivery environments.</p>	
Public Policy in Health Care	2.0
<p>This course offers political and analytical insights into understanding US health policy making and into developing strategies that influence health policy outcomes. The course presents an analysis of the functions of the public and private sectors in creating and implementing health policy across diverse patient populations. The role of political and social philosophy in defining nursing and health services is examined. The course includes consideration of areas in which policy made by multiple branches of government and various types of public and private organizations significantly affects nursing as a profession and its ability to deliver care; regulation of professional practice; and the impact of public policy on patient health outcomes.</p>	
Nurse Anesthetist Role Seminar	1.5
<p>This course prepares the nurse anesthesia student for their new role as a CRNA and advanced practice registered nurse (APRN). Areas of professional responsibility and potential professional roles will be addressed, including APRN, educator, military member, consultant, self-employed practitioner, CRNA clinician, leader, change agent, organizational leadership position, and administrator. Licensure, accreditation, certification, and educational requirements for CRNAs as APRNs will be reviewed. Pathways to active involvement in community service and legislative advocacy will be discussed and analyzed. Legal, financial, malpractice, and ethical issues related to nurse anesthesia practice will be addressed.</p>	
Advanced Clinical Care 2	1.5
<p>Cardiothoracic, cardiovascular, and vascular (three days/week)</p> <p>This fourth clinical course is designed to assist the nurse anesthesia student to integrate advanced clinical concepts being covered concurrently in the classroom with the clinical experience. Primary focus will be on specialty case management, including cardiovascular, thoracic, and vascular anesthesia. Advanced airway techniques and sophisticated laboratory analysis will be included. Students will be assigned to affiliated clinical sites and anesthesia-related specialty areas to manage increasingly complicated and specialty cases. Clinical experiences will be guided by CRNAs and/or anesthesiologists. Supplemental clinical case conferences will be conducted with a focus on these specialty populations.</p>	
Term total	11.0
Second year total	31.0

YEAR 3, TERM 7 (SPRING)

Finance and Economics for Health Care Leaders

3.0

This course is designed to familiarize clinical leaders with the basic concepts of business, economics, and financial management in health care organizations. Students will learn key financial terms; the relevance of health care finances in today's environment; the ability to develop and monitor budgets for practice initiatives; and the business and financial acumen needed to evaluate and design effective practice changes. The course utilizes financial and clinical data to allow clinical leaders to learn how to effectively balance the administrative and clinical needs of today's health care environment.

Advanced Principles of Anesthesia 3

3.0

The third course in the advanced principle series provides in depth study of specialized areas of nurse anesthesia practice. Lectures concentrate on the evidence base for specific anesthetic and surgical interventions. Anesthetic approaches and management plans for patients with traumatic injuries, burns, alterations of hemostasis, hematologic disorders, and neuropathology and pulmonary conditions will be reviewed. Neurosurgical, diagnostic radiology, solid organ transplant, trauma, reconstructive, and plastic surgery procedures will be reviewed. Current techniques and technology related to safe management of care for patients undergoing procedures involving these areas will be examined. Interactive workshops in managing trauma and performing invasive and non-invasive procedures will allow development of psychomotor skills in caring for burn and trauma patients. This course will also focus on principles of scientific writing for publication.

Capstone Project

2.0

Students will undertake a systematic investigation of a clinically-based or administration-based problem selected by the student and supported by faculty. Course requirements include identification of the problem to be addressed, review and critique of pertinent literature, and implementation of the project. The project will use an evidence-based practice model, and it will be systematically developed in consultation with the student's capstone committee who will evaluate each step of the process. This process can begin research for evidence-based practice 2.

Advanced Clinical Care 3

1.5

Neurosurgical, trauma, and emergency (three days/week). This fifth clinical course builds upon experiences gained in prior courses. The focus will be on demonstration and refinement of more advanced skills as well as incorporating content-specific plans of care for neurosurgical, neurovascular, trauma, renal, hepatic and emergency procedures. Students will also demonstrate the ability to manage complex pathophysiology. Student will gain an awareness of the broader professional roles and responsibilities of the CRNA (administrative, patient advocacy, process, and patient safety evaluator). Supplemental clinical case conferences will be conducted with focus on these specialty populations and the CRNA role.

Term total

9.5

YEAR 3, TERM 8 (SUMMER)

Introduction to Health Informatics

3.0

This course focuses on a conceptual foundation for understanding nursing informatics and includes analysis of various applications of information systems within the context of the health care system. This course introduces theoretical models of nursing informatics; healthcare computing; and systems design and analysis. Other topics include nursing vocabularies, nursing knowledge generation; ethical and social issues in healthcare informatics; and the impact of consumer health informatics.

DNP Project Clinical	1.0
This practicum represents the final clinical course for the DNP degree. Here, the student will experience a mentored and supervised immersion in a clinical practice where the project designed and approved in the capstone project course will be implemented and evaluated. The practice site, approved by the capstone committee, must provide access to the necessary and appropriate population for project implementation, as well as support for full expression of the DNP scope of practice.	
Manuscript Development	1.0
This course focuses on the process of preparing a manuscript for possible publication. Attention is directed toward selecting an appropriate journal, the organization of the paper, relevant legal and ethical issues, single vs. multiple authorship, refining one's writing skills, and the development and preparation of a manuscript for submission to a peer-reviewed journal.	
Advanced Clinical Care 4	2.0
Synthesis of perioperative care (four days/week). This sixth clinical course builds upon experiences in prior courses and is designed to help the student refine their knowledge base and develop increasing sophistication in practice. Students will be able to provide care for any combination of patient acuity level and complexity of procedure across the lifespan. Clinical experiences will be guided by student nurse anesthetists and/or anesthesiologists. Integrated clinical case conferences will require students to present their patients and defend their plan of care with rationale based on best practices.	
Term total	7.0
YEAR 3, TERM 9 (FALL)	
Comprehensive Anesthesia Review Seminar	2.0
This course is designed to comprehensively review the body of knowledge necessary to enter nurse anesthesia practice. Nurse anesthesia student preparation for both the DNP comprehensive examination and the National Board of Certification and Recertification for Nurse Anesthetists examination will be enhanced. Review topics will include: basic science, equipment, instrumentation, technology, basic principles of anesthesia, and advanced principles of anesthesia. A series of seminars and presentations interspersed with comprehensive, computerized examinations will be administered to allow students to evaluate their knowledge level and their test taking skills.	
Transition to Clinical Practice	2.0
This final clinical course is designed to help the student transition from the student role to clinical practice. Students will be expected to create sophisticated patient and case-specific management plans. Clinical experiences will be guided by CRNAs and/or anesthesiologists, but students will be expected to practice with little or no prompting from their clinical supervisors and understand their limitations. Clinical experiences will include specialty cases and experiences in all areas of practice as assigned. Clinical case conferences will be held that challenge the breadth of the students' knowledge base across the full scope of the clinical and professional role of the CRNA.	
Term total	4.0
Third year total	20.5