

The role of Certified Registered Nurse Anesthetists in the United States

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Abstract Certified Registered Nurse Anesthetists (CRNAs) have been providing anesthesia care in the United States (US) for nearly 150 years. Historically, anesthesia care for surgical patients was mainly provided by trained nurses under the supervision of surgeons until the establishment of anesthesiology as a medical specialty in the US. Currently, all 50 US states utilize CRNAs to perform various kinds of anesthesia care, either under the medical supervision of anesthesiologists in most states, or independently without medical supervision in 16 states; the latter has become an on-going source of conflict between anesthesiologists and CRNAs. Understanding the history and current conditions of anesthesia practice in the US is crucial for countries in which the shortage of anesthesia care providers has become a national issue.

Keywords Nurse anesthetists · United States · Anesthesia practice

Introduction

Anesthesiologists are in seriously short supply in some countries. For example in Japan, a 2004 Survey conducted by the Ministry of Health, Labor, and Welfare reports that the number of anesthesiologists per capita was just 40% of that in the US [1]. The shortage of anesthesia care providers could result in delay or cancellation of scheduled surgery, or forced overtime work.

Such a shortage of anesthesia care providers has not been experienced in the United States (US), where Certified Registered Nurse Anesthetists (CRNAs) have been incorporated into the anesthesia work force along with anesthesiologists. Nurse anesthetists have been providing anesthesia care in the US for nearly 150 years. CRNAs are advanced practice registered nurses who receive master's level education and training with national board certification in the nurse anesthesia specialty. The American Association of Nurse Anesthetists (AANA), founded in 1931, is a professional association representing more than 92% of CRNAs in the US. The AANA 2009 Practice Profile Survey reports that CRNAs administer approximately 32 million anesthetics to patients each year in the United States.¹ Most CRNA-provided anesthesia has been performed under the medical supervision of anesthesiologists. However, recent legislative changes have allowed CRNAs to independently practice anesthesia in 16 states; this legislation has resulted in significant conflict between anesthesiologists and CRNAs in the US.

In this article, we detail the history, education system, and working conditions of CRNAs in the US. We believe that understanding the conditions surrounding CRNAs, including the ongoing political conflict with anesthesiologists, would be helpful for countries where the shortage of anesthesia care providers has become a major problem to be addressed.

History of CRNAs in the US (Table 1)

In the 1800s, anesthesia was often provided by medical students under the supervision of surgeons and nurses,

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¹ Certified Registered Nurse Anesthetists (CRNAs) at a Glance. Available at: <http://www.aana.com/ataglance.aspx>

Table 1 History of anesthesia: anesthesiologists and CRNAs in the United States

Year	Event
1700s	Many surgical patients died because of inadequate anesthesia administered with nitrous oxide, alcohol, and opium
1842	Dr Crawford Long used ether successfully to remove a cyst
1846	William T. G. Morton (a dentist) demonstrated ether anesthesia at MGH
(1847)	(General anesthesia was performed in France, Germany, China, Australia)
1861–65	Civil War: Catherine S. Lawrence was the first nurse to provide anesthesia
1877	Sister Mary Bernard at St Vincent's Hospital (Erie, Pennsylvania) worked as the first nurse anesthetist
1880–90	Catholic church nurses performed anesthesia
1889	At St Mary's Hospital, Dr Charles H. Mayo taught anesthesia the nurses
1899	Alice Magaw (the "Mother of Anesthesia") provided anesthesia at the Mayo Clinic and published "Observations in Anesthesia"
1905	First physician anesthetists
1906	Alice Magaw published "A Review of over 14,000 Surgical Anesthetics"
1908	Dr George Crile (surgeon) in Cleveland Clinic (Lakeside) selected Agatha Hodgins as his special anesthetist
1909	Agnes McGee established the first nurse anesthesia school at St Vincent's Hospital, Portland, OR, USA
1911	Dr Francis McMechan organized anti-nurse anesthetist activity
1911	Dr McMechan helped physician anesthetists establish the New York State Society of Anesthetists (NYSSA), which succeeded the Long Island Society of Anesthetists
1912	NYSSA petitioned the American Medical Association to create a section on anesthesia at its annual meeting, but failed.
1913	Associated Anesthetists of America (AAA) was established by Dr J. T. Gwathmey.
1915	Interstate Association of Anesthetists (IAA) was organized.
1912–1920	World War I: Nurse Anesthetist Program was established
1916	Lakeside Challenge: a legal challenge by IAA to the Lakeside Hospital School of Anesthesia of the anesthesia provided by nurses
(1921)	(Canadian Society of Anesthetists)
1931	Agatha Hodgins established National Association of Nurse Anesthetists (NANA)
1935	Physician Anesthetists established American Society of Anesthetists (ASA)
1939	NANA was renamed the American Association of Nurse Anesthetists (AANA)
1939–1945	World War II
1940	There were 285 anesthesiologists in the US.
1945	ASA was renamed the American Society of Anesthesiologists (ASA)
1952	AANA established educational institution for nurse anesthetists
(1954)	(Japanese Society of Anesthesiologists)
1957	Certified Registered Nurse Anesthetists (CRNA) certification was established
1975	Council on accreditation of Nurse Anesthesia Educational Program
1977	AANA continuing education was established
1981	The CRNA educational guideline was established
1986	US government permitted direct reimbursement for solo CRNA care
2001	In Iowa, CRNAs became independent from anesthesiologists
2002–2009	The requirement for medical supervision of CRNAs was lifted in Nebraska, Idaho, Minnesota, New Hampshire, New Mexico, Alaska, Kansas, Montana, North Dakota, South Dakota, Oregon, Washington, Wisconsin, California, and Colorado
2007	AANA has 36,000 members and ASA has 42,330 members

CRNA Certified Registered Nurse Anesthetist; MGH Massachusetts General Hospital

which resulted in frequent intraoperative patient deaths. Consequently, surgeons trained nurses to provide anesthesia for their patients, and found them more reliable. This practice became common and attracted nuns to nursing certifications in Christian hospitals. In 1877, Sister Mary Bernard was the first nurse to specialize in nurse anesthesia at St Vincent's Hospital in Erie, Pennsylvania. These nurses, who learned anesthesia from surgeons, provided a

large portion of anesthesia care for the wounded during World War I. Still, there were no formal educational institutions or training systems for anesthesia in the early 1900s. Anesthesia care providers also varied; they included physicians and dentists, as well as nurses.

In 1909, the first nurse anesthesia school offering a master's level degree was established at St Vincent Hospital in Portland, Oregon by Agnes McGee, who was a

nurse anesthetist.² Nurses, along with physicians and dentists, learned together in the programs for six months; the curriculum included courses on anatomy, physiology, pharmacology, and administration of common anesthetic agents.

In 1910, physician anesthetists started to campaign for anesthesia to become solely physicians' work, based on the development of anesthetic technologies and the alleged possibility of anesthesia-related complications under the care of non-physician anesthetists. Three lawsuits were filed against nurse anesthetists for illegally practicing medicine: Frank versus South in 1917, Hodgins and Crile in 1919, and Chalmers-Francis versus Nelson in 1936 [2]. The verdicts in all cases were found in favor of the nursing profession. In 1936, the American Society of Anesthetists (ASA) was established by physician anesthetists; in 1945, the name was changed to American Society of Anesthesiologists. Since then, the US government started investing in anesthesia residency programs in academic institutions and the number of anesthesiologists increased substantially between 1970 and 2000.

Meanwhile, nurse anesthetists independently established the National Association of Nurse Anesthetists in 1931. The name was changed to the American Association of Nurse Anesthetists (AANA) in 1939. The training system for nurse anesthetists was unified and established as a master's degree level of education. Its national certification system was also established. The name "Certified Registered Nurse Anesthetists" was first introduced in 1956, and CRNAs continued to perform anesthesia care under medical supervision.

In 2001, the Medicare rules for furnishing anesthesia services in hospitals were changed by removing a federal requirement that a physician must supervise every case of anesthesia administered by a CRNA, allowing each state to determine whether such medical supervision is needed.³ This new rule eliminated the requirement that physicians must supervise CRNAs in order for the federal government to pay for anesthesia. Thus, the power to decide whether CRNAs would be reimbursed for anesthesia administration without supervision resides in states' licensing statutes and hospital policy. If a specific state does not require CRNA supervision, hospital policy may ultimately decide whether CRNAs may administer anesthesia without supervision. CRNA-supported organizations back numerous proposed legislative changes in various states that would allow such

independent practice, while organizations supporting anesthesiologists have fiercely challenged such legislation. Currently, 16 states have removed the obligation of physicians to supervise CRNAs.

In 2007, 42,330 ASA members (anesthesiologists) and 36,000 AANA members (CRNAs) were registered as anesthesia care providers. CRNAs practice in all 50 US states and administer approximately 32 million anesthetics each year. Approximately 65% of CRNAs practice in collaboration with anesthesiologists.

Education and clinical training

Application for the training program

To become a CRNA, a master's degree at an accredited nurse anesthesia educational program is required. In 2011, 111 programs in 38 states exist for students (student registered nurse anesthetists, or SRNAs).⁴

Over 2,000 students were admitted in 2009. To enter the program, the candidate must have:

- 1 a degree of Bachelor of Science in Nursing (BSN);
- 2 the certification of registered nurse; and
- 3 working experience as a registered nurse for at least one year in an intensive care unit (ICU).

Some universities require credits in science and physics.

Education and training

The nurse anesthesia educational program is 2–3 years in duration. The program includes both lectures and clinical training in anesthesia. The blueprint for the certification exam is determined by the National Board of Certification and Recertification of Nurse Anesthetists (NBCRNA). Nurse anesthesia programs are accredited by the Council on Accreditation. The content of the lectures in nurse anesthesia programs is based on the blueprint from the NBCRNA, and includes anatomy, physiology, pathophysiology, pharmacology, applied chemistry, biochemistry, physics, equipment, instrumentation, technology, basics of anesthesia, advanced principles of anesthesia, and professional issues.⁵ In addition to these courses, most master's programs include advanced practice nursing courses on evidence-based practice, physical exam, statistics, and health promotion. In clinical training, an SRNA is required

² Historical Resources. Available at: <http://www.aana.com/Resources.aspx?id=2049>

³ Medicare and Medicaid Programs; Hospital Conditions of Participation: Anesthesia Services. Available at: <http://www.gpo.gov/fdsys/pkg/FR-2001-11-13/html/01-28439.htm>

⁴ Accredited Nurse Anesthesia Programs. Available at: <http://webapps.aana.com/AccreditedPrograms/accreditedprograms.asp?State=all>

⁵ The National Board on Certification and Recertification of Nurse Anesthetists (NBCRNA). Available at: <http://www.nbcna.com/>

Table 2 Summary of “Scope and Standards of Nurse Anesthesia Practice” (see footnote 7)

1. Performing and documenting a pre-anesthetic assessment and evaluation of the patient
2. Developing and implementing an anesthetic plan
3. Initiating the anesthetic technique which may include: general, regional, local, and sedation
4. Selecting, applying, and inserting appropriate non-invasive and invasive monitoring modalities
5. Selecting, obtaining, and administering of the anesthetics, adjuvant and accessory drugs, and fluids
6. Managing a patient’s airway and pulmonary status using current practice modalities
7. Facilitating emergence and recovery from anesthesia
8. Discharging the patient from a post-anesthesia care area and providing post-anesthesia follow-up evaluation and care
9. Implementing acute and chronic pain management modalities
10. Responding to emergencies by providing airway management, administration of emergency fluids and drugs, and using basic or advanced cardiac life-support techniques

to perform more than 550 anesthesia cases with over 1,694 h of clinical experience.⁶

During anesthetic management of patients, an SRNA must be supervised by a CRNA or an anesthesiologist at all times. After graduating from the training program, an SRNA has to pass the national board examination to become a CRNA. Currently, 1,300–1,700 students graduate every year [3]. CRNAs must be recertified every 2 years; certification requirements are based on hours of practice and the acquisition of at least 40 continuing education credits.

Scope of practice

The AANA defines the “Scope and Standards of Nurse Anesthesia Practice”, guidelines for CRNA anesthesia management (Table 2).⁷ CRNAs are able to independently make working contracts with university hospitals, community hospitals, day-surgery centers, or dental clinics. They can join existing anesthesia groups.

Obligation of anesthesiologist supervision

In most of the states in the US, CRNAs are required to practice under medical supervision, chiefly by anesthesiologists, but they can also be supervised by surgeons and dentists.

In such a system, CRNAs work as “hands-on” care providers (anesthesia care providers who constantly attend

to the patients under anesthesia) along with anesthesiology resident physicians in university hospitals. An attending anesthesiologist (a board-certified or eligible anesthesiologist) concurrently supervises two to four hands-on care providers (CRNAs and/or anesthesiology resident physicians). The supervising anesthesiologist has to physically attend the key portions of anesthetic management, including pre-anesthesia evaluation, induction, emergence, placement of invasive monitoring, post operative care, and any emergent conditions.

However, CRNAs do not have the obligation of medical supervision in 16 states (see footnote 3). CRNAs tend to be the sole anesthesia providers in the vast majority of rural hospitals in these states [4], affording these facilities surgical and obstetrical services, trauma stabilization, and interventional diagnostic and pain management capabilities.

Clinical insurance payment for CRNA-provided anesthesia

Payments from medical insurance for anesthesia care vary depending on the individual state and on the style of the practice.

For example, in the state of California, a hospital can recover 100% of anesthesia costs from an insurance company when a CRNA provides anesthesia care independently. However, Medicare or Medicaid patients, the hospital can only recover 70% of the cost from insurance with the independent CRNA practice, and insurance pays 100% if the CRNA works under anesthesiologist supervision. In this state, the above payment rule is applied to the practice in which each anesthesiologist is limited to simultaneously supervising a maximum number of four CRNAs. On the other hand, in North Carolina, Medicare pays 100% of the cost of anesthesia care provided by a CRNA working solely without medical supervision, which is the same revenue for the hospital when an anesthesiologist supervises a CRNA [5]. In the state of Texas, private

⁶ American Association of Nurse Anesthetists. Education of Nurse Anesthetists in the United States; At a Glance 2008. Available at: <http://www.aana.com/BecomingCRNA.aspx?ucNavMenu-TSMMenuTargetID=18&ucNavMenuTargetType=4&ucNavMenu-TSMMenuID=6&id=1018>

⁷ Scope and Standards for Nurse Anesthesia Practice. Available at: http://www.aana.com/uploadedfiles/resources/practice_documents/scope_stds_nap07_2007.pdf

insurance companies used to pay for independent CRNA anesthesia care only 85–90% of the cost for the care by anesthesiologists. In such states, the AANA sent letters of appeal to private insurance companies for payment equal to anesthesiologists, stressing the safety record of CRNA care, and contribution to society. Currently, the strategy has been working and the insurance payment for independent CRNA anesthesia care has been increased [6].

Malpractice insurance costs for CRNAs also differ significantly among institutions and states. The premium for medical malpractice insurance (covering a total of \$300,000 damages annually; \$100,000 per case) is most expensive in California (approx. \$10,000 annually) and least expensive in South Carolina (approx. \$1,130 annually) [7]. In terms of institutions, insurance tends to be more expensive for those working in small surgery centers compared with those working in large medical centers.

Cost effectiveness of CRNA practice

The AANA claims that introducing CRNAs to anesthesia care has greatly contributed to the reduction in anesthesia care costs. The average annual CRNA income (approx. \$160,000 in 2005),⁸ which is one of the highest salaries for nursing professions in the US (mean annual wage of \$66,530 in 2009),⁹ but is less than that of anesthesiologists (mean annual wage of \$211,750 in 2009).¹⁰ The AANA claims that the educational cost to train a CRNA is much less than that for an anesthesiologist; in 1992, the average annual schooling cost for one SRNA was \$11,741 whereas that for an anesthesiology resident was \$84,837. Also, the length of education for SRNAs (2–3 years) is shorter than that of anesthesiology residents (4 years after graduation from medical school). After high school graduation, it usually takes 7–8 years to become a CRNA whereas it requires at least 12 years to become an anesthesiologist. A recently published simulation study also suggested the cost effectiveness of CRNA practice [8].

The ASA, which is a main political organization for anesthesiologists in the US, strongly opposes the above

claim.¹¹ Abenstein and associates [9] developed an ad-hoc model to estimate the cost-effectiveness of physician-directed anesthesia relative to a nonmedically directed nurse anesthetist model of care from the payer perspective. Based on a reference case, physician anesthesia was cheaper, with an estimated incremental cost-effectiveness ratio of $-\$2,601/\text{year}$ of life saved (YLS) for a younger privately insured patient and an estimated cost-effectiveness ratio of $-\$4,410/\text{YLS}$ for an elderly Medicare insured patient [9].

Quality of anesthesia management by CRNAs

Anesthesia safety has improved dramatically; estimated incidence of anesthesia-related death was 1.1 per million population per year and 8.2 per million hospital surgical discharges, on the basis of US multiple-cause-of-death data files for the years 1999–2005 [10]. Several studies have been conducted to try to address the question of whether there is a significant difference in outcome between anesthesia care provided with anesthesiologist supervision or without anesthesiologist supervision.

Torgersen and Chamings showed that there was no significant difference in the quality of anesthesia management between CRNAs and anesthesiologists [11]. In 1990, Jordan et al. [12] showed that the Centers for Disease Control planned to review the pilot study on anesthesia outcomes; however, it was predicted that the study would cost over \$150 million for five years if they investigated 290 hospitals in the US with a specificity of 35%. Because this was too expensive, they stopped the project.

Silber and associates [13] demonstrated in 2000, using Medicare claims records of all elderly patients in Pennsylvania who underwent general surgical or orthopedic procedures with 194,430 anesthesiologist-directed and 23,010 anesthesiologist-undirected anesthesia care among 245 hospitals between 1991 and 1994, that the adjusted death and failure-to-rescue odds ratios were greater when care was not directed by anesthesiologists (death odds ratio = 1.08, $P < 0.04$; failure-to-rescue odds ratio = 1.10, $P < 0.01$), whereas complications were not increased (complication odds ratio = 1.00, $P < 0.79$). This result corresponded to 2.5 excess deaths/1,000 patients and 6.9 excess failures-to-rescue (deaths in the first 30 days after

⁸ Questions and Answers: A Career in Nurse Anesthesia. Available at: <http://www.aana.com/BecomingCRNA.aspx?id=110&linkidentifier=id&itemid=110>

⁹ Occupational Employment and Wages, May 2009: 29-1111 Registered Nurses. Available at: <http://www.bls.gov/oes/2009/may/oes291111.htm>

¹⁰ Occupational Employment and Wages, May 2009: 29-1061 Anesthesiologists. Available at: [http://www.bls.gov/oes/current/oes291061.htm#\(5\)](http://www.bls.gov/oes/current/oes291061.htm#(5)).

¹¹ Abouleish, AE, Stead SW, Cohen NA. Myth or Fact? Nurse Anesthetists Cost Less Than Anesthesiologists. ASA Newsletter 2010;74 (Dec): 31-34. Available at: <http://viewer.zmags.com/publication/8de38f6e/#8de38f6e/32>

surgery) per 1,000 patients with complications [13]. In this study, Silber and colleagues assumed that 14,137 patients would be cared for by CRNAs without anesthesiologist supervision, because anesthesia care for these patients was not billed. These patients, without description of the actual care providers' identification, accounted for 61% of the total number (23,010) of patients with “anesthesiologist-undirected anesthesia care”.

On the other hand, several recently published AANA funded studies demonstrated the non-inferior outcome of the anesthesia care provided either by CRNA-only or by a combination of CRNAs and anesthesiologists compared with that by anesthesiologist-only, using an obstetric anesthesia care database [14] or Medicare database [15, 16].

Societies for CRNAs

Besides the AANA there are several societies for CRNAs in the US. The CRNA political action committee (CRNA-PAC), which is backed by AANA, was established in order to increase the status of CRNAs among the medical specialties. The group supports politicians, both Democrat and Republican, who have favorable opinions for the promotion of the activities by CRNAs and help legislators who promote bills to support a wider scope of practice by CRNAs (non-medical supervision, increased insurance payment, and other issues).

The International Federation of Nurse Anesthetists (IFNA) is the international committee for nurse anesthetists. Since its inception in 1989, the IFNA has a major objective of advancing educational standards and practices that support and enhance patient care and safety [17].

Anesthesiologist assistant

An anesthesiologist assistant (AA), also known as anesthesia assistant, functions as a specialty physician assistant under the direction of anesthesiologists.¹² The AA's responsibilities, in the hospital setting, are identical with those of a CRNA. The Boards of Medicine and Osteopathic Medicine approved the first AA license in Florida in 2005. Florida is considered a key state with regard to the licensing of AAs throughout the US. AAs currently work in 18 states (Florida, Georgia, Colorado, South Carolina, North Carolina, Alabama, Kentucky, Missouri, New Mexico, Ohio, Oklahoma, Vermont, District of Columbia,

Michigan, New Hampshire, Texas, West Virginia and Wisconsin). Approximately 700 anesthesiologist assistants (AA) with this certification have been working in the field of anesthesia. There are currently five AA schools in the US, for which a candidate must have a master's degree in a humanity or science. Nurse certification is not mandatory. They can receive a degree (a bachelor of arts degree or a bachelor of science degree) through a 24–28 month program. The average AA annual salary in 2006 was \$95,000–120,000. The AANA and other nursing organizations duly oppose the spread of the AA system in other states.

Anesthesiology care providers in other countries (Table 3)

Among the developed countries, the number of anesthesiologists per member of the population is lower in Japan than in other countries.¹³ Aside from the US, countries which have a smaller number of anesthesiologists per member of the population (i.e. the United Kingdom and New Zealand) have adopted the AA system.^{14,15,16} The CRNA system seems to exist in the US only.

The demand for anesthesia services will continue to increase. Even in Western European countries which have a higher number of anesthesiologists per member of the population, steps to augment the anesthesia care system has been advocated to ensure the supply of a sufficient number of anesthesiologists to meet the demand [18, 19].

Conclusion

The history of anesthesia care in the US has clearly demonstrated that nurse anesthetists and physician anesthetists co-existed from the beginning. Although the political turf-battle between ASA (anesthesiologists) and AANA (CRNAs) is likely to continue, the vast majority of anesthesia care is safely and efficaciously provided by cooperation between anesthesiologists and CRNAs in the US. Proper understanding of the nature of the anesthesia care involving CRNAs in the US is important in discussion of strategies to solve the problem of national shortages of anesthesia care providers.

¹³ The Japanese Society of Anesthesia. Available at: <http://www.anesth.or.jp/english/tips.html>

¹⁴ Australian Society of Anesthesia. Available at: <http://www.anzca.edu.au/news/bulletin/bulletin-oct>

¹⁵ Grogono AW: Anesthesiology Recruitment. Available at: <http://www.grogono.com/nrmp/>

¹⁶ Australian and New Zealand College of Anaesthetists. Available at: <http://www.anzca.edu.au/news/bulletin/bulletin-oct>

¹² The American Academy of Anesthesiologist Assistants. Available at: <http://www.anesthetist.org/>

Table 3 Anesthesiology care providers in the US and other countries

	Germany	Sweden	Australia	USA	France	Switzerland	NZ	UK	Japan
Anesthesiologists	16,437	1,640	3,769	50,000	8,900	1,069	535	6,400	5,989
Population (millions)	82.5	9	21.1	306	60.7	7.4	4.2	59.9	127
Anesthesiologists/population (million)	199	182	179	163	147	144	126	107	47
CRNA	–	–	–	Yes (44,000)	–	–	–	–	–
Anesthesiologist Assistant	–	–	–	Yes (1,000)	–	–	Yes (n/a)	Yes (n/a)	–

“Anesthesiologists” indicates the number of board-certified/eligible anesthesiologists

USA United States of America; NZ New Zealand; UK United Kingdom; CRNA Certified Registered Nurse Anesthetist; n/a not available

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