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Nurse Anesthetist's Perceptions Regarding Utilization of Anesthesia Support Personnel

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NURSE ANESTHETISTS' PERCEPTIONS REGARDING UTILIZATION OF ANESTHESIA SUPPORT PERSONNEL

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

by

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Anesthesia support personnel (ASP) provide direct support to health care providers administering anesthesia (Certified Registered Nurse Anesthetists [CRNAs] and anesthesiologists). Because these anesthesia providers are caring for a patient whom they cannot legally or ethically leave unattended, ASP are employed to bring them extra supplies or equipment, prepare equipment for the case, maintain and clean equipment, and generally function as directed by the anesthesia provider. Given the limited literature and importance of ASP in maintaining equipment essential to safe practice, it is necessary to describe the population to understand who is functioning in this role to insure that these individuals are trained and capable of complying with safety standards.

There are two studies in the literature describing this population. The first study presents a descriptive survey of ASP utilization in anesthesiology residency training programs revealing varied utilization and qualifications of ASP (McMahon & Thompson, 1987). The second study

is a survey of a convenience sample of the membership of the professional organization of ASP, which offers voluntary certification (American Society of Anesthesiology Technologists and Technicians). This survey reveals variation in utilization and qualification of ASP as well.

The present prospective descriptive survey of CRNAs working with ASP was conducted to describe this population in terms of their educational characteristics and training, specific job functions, and work environment. It further evaluated perceptions of practicing CRNAs regarding the utilization of ASP. The results of this study were consistent with that of previous work and indicated that ASP utilization varies by hospital but has a propensity for greater utilization at larger medical centers that have a level I or II trauma designation. Formal ASP supervision is limited, which restricted the results to CRNA reports of tasks ASP performed and perceptions of CRNAs regarding ASP. ASP tasks tended to be limited to more equipment cleaning and maintenance type tasks with a smaller portion of ASP performing tasks related to direct patient care. Overall, the description of ASP in the literature remains variable and further research is needed to adequately describe this population and begin to develop a common language to understand this practice group.

CHAPTER 1. INTRODUCTION

Background for the Study

Approximately 28 million anesthetics are conducted annually in the United States (American Association of Nurse Anesthetists, 2008a; Wiklund & Rosenbaum, 1997). The incidence of death related to anesthesia has been reduced from greater than 1 per 1,000 cases (Bankert, 1993) at the time of initial documented medical uses of anesthesia to less than 1 in 250,000-500,000 currently (Gravenstein, 2002; Lagasse, 2002; Voelker, 1995). This dramatic reduction in mortality is attributed to educational and practice standards for anesthesia providers and equipment advances allowing greater monitoring and preemptive planning for complicated cases. The safety record of anesthesia is the result of ongoing efforts by pioneers in the fields of anesthesia, surgery, biomedical engineering, and other surgical support specialties.

The first documented use of anesthetics was through recreational experimentation such as "ether frolics" and nitrous oxide use at parties (Gunn, 2001). Prior to the discovery of the anesthetic potential of these agents, the development of surgery and dental procedures had been stifled by the degree of pain imposed on patients. The possible applications of these agents piqued the interest of a few notable surgeons and dentists. On October 16, 1846, William Morton, a Boston dentist, anesthetized a patient for surgeon John Collins Warren to remove a neck tumor (Bankert, 1993; Gunn, 1991). This took place in what is now known as the "ether dome" at Massachusetts General Hospital (Gunn, 2001; Thatcher, 1953). At the conclusion of

the procedure, “Warren is supposed to have made the classic statement: ‘Gentlemen, this is no humbug’”(Thatcher, 1953, p. 11). Following this occurrence and similar presentations, anesthesia was met with great interest. The number of surgeries increased about three-fold allowing more patients access to life-saving or enhancing surgical procedures. This increase in the amount of surgery increased demand for professionals, instruments, and equipment to support surgical interventions.

The advancing popularity of surgery and anesthesia brought with it the need for someone to provide anesthesia services (Gunn, 2001; Thatcher, 1953). Since the anesthetic properties of these agents were recent discoveries, limited numbers of people were experienced or trained in their use. From its discovery, the practice of anesthesia had been a task relegated to an assistant and was deemed subservient in the overall surgical process (Thatcher, 1953). In some isolated communities, surgeons employed bystanders and family members to provide anesthesia. In hospitals, medical students or interns performed the anesthesia. Early in its development, anesthesia was associated with a high mortality rate—with some estimates greater than 1 per 1,000 anesthetics (Bankert, 1993). These poor outcomes were attributed to the general lack of consistency in qualification and experience of those administering the anesthetic. Anesthetic mortality was and remains most commonly the result of asphyxia, leading to lack of adequate oxygenation of the tissues and subsequent cardiovascular collapse (Stoelting & Miller, 2000). Many prominent surgeons throughout the medical community retained a single individual to be trained to administer all of their anesthetics (Bankert, 1993). This person was often a female nurse who would work for less money, would be content with the role of anesthetist, and would not be distracted by the surgery.

In 1900, Alice Magaw, a nurse anesthetist at the Mayo clinic in Minnesota, reported on 1,092 anesthetic cases in which there were no fatalities (Thatcher, 1953). These anesthetic cases were administered via an esmarch mask, which is an open technique that allows greater oxygen delivery to the patient, thereby reducing mortality. At that time, this was the lowest mortality rate ever reported and of great interest to many surgeons. Simultaneously, advances in surgical technology prompted efforts to enhance education and performance in the subspecialties supporting surgery. This, in turn, led to the development of professional organizations to promote educational and professional standards (Bankert, 1993; Thatcher, 1953).

While advances in professionalism increased the safety and acceptance of anesthesia as a means to achieve surgical outcomes, technological advances were equally important in contributing to patient safety. The endotracheal tube was invented to offer the ability to ventilate the patient's lungs with oxygen via a closed system that dramatically reduced the risk of aspiration and death (Stoelting & Miller, 2000). Equipment to monitor patients improved to allow earlier detection of a patient's deteriorating physical status. The safety and number of anesthetics and surgeries continued to increase. Presently, it is estimated that there are 28 million anesthetics conducted annually (American Association of Nurse Anesthetists, 2008a; Wiklund & Rosenbaum, 1997) with a mortality rate of 1 in 250,000-500,000 (Gravenstein, 2002; Lagasse, 2002; Voelker, 1995).

Currently, the American Society of Anesthesiologists (ASA) (2005) and the American Association of Nurse Anesthetists (AANA) (2007) publish standards that must be adhered to for every anesthetic case. These standards include monitoring and documentation of basic vital signs: blood pressure, heart rate, respiration, and oxygen saturation at a minimum of every 5 minutes and more frequently as indicated. In complex cases, these minimum standards are

surpassed by the use of invasive monitoring of the pressures within the heart and directly within the peripheral arteries. Additionally, there is the availability of many different types of airway and ultrasound equipment at the disposal of the anesthesia team to facilitate rapid, life-saving interventions when used appropriately (Dorsch & Dorsch, 2008). The availability of airway monitoring and ultrasound equipment in good working order is now the standard of practice in anesthesia because it has proven essential in the reduction of anesthesia related mortality. There are also standards for equipment cleaning and maintenance. These standards are established for each piece of equipment and published by the manufacturer.

The introduction of equipment and technology has left the practice of anesthesia with the new problem of maintaining and cleaning this additional equipment to ensure it is constantly available and in good working order. Proper cleaning and maintenance is essential since this equipment facilitates airway management that directly decreases the risk of asphyxia and inadequate oxygenation. Additionally, improper cleaning of this equipment has been directly related to increased incidence of infections, pneumonia and chemical burns (Baillie, Sultan, Graveling, Forrest, & Lafong, 2007; Cupitt, 2000; Garrett & Hough, 2000; Hall, 1994; Maslyk, Nafziger, Burns, & Bowers, 2002; Venticinque, Kashyap, & O'Connell, 2003).

Anesthesia support personnel (ASP) serve as support to practicing anesthesia providers. In some practice settings they provide direct support to providers administering anesthesia (certified registered nurse anesthetists [CRNAs] and anesthesiologists) in an operating room. Because these anesthesia providers are caring for a patient whom they cannot legally or ethically leave unattended, ASP are employed to bring them extra supplies or equipment, serve as an additional "pair of hands" during intense portions of the case, prepare fluid setups or other equipment for the case, maintain and clean equipment, and generally function as directed by the

anesthesia provider. Anesthesia providers in institutions that utilize ASP often regard them as valuable at maintaining and cleaning equipment as well as providing direct support to staff.

Overview of the Study

Oxygen deprivation is the leading cause of morbidity and mortality related to general anesthesia. Improperly maintained equipment has been shown to be directly related to inadequate oxygenation, increased infections, pneumonia and burns (Baillie et al., 2007; Cupitt, 2000; Garrett & Hough, 2000; Hall, 1994; Maslyk et al., 2002; Venticinque et al., 2003). Properly maintained equipment is essential to promote patient safety (Dorsch & Dorsch, 2008). Given the importance of ASP in cleaning and maintaining equipment and the limited literature regarding this group, it is necessary to describe the population to better understand who is functioning in this role to ensure that these individuals are trained and capable of complying with safety standards. There are only two studies in the literature describing this safety enhancing population. The first study presents a descriptive survey of anesthesia support personnel utilization in anesthesiology residency training programs (McMahon & Thompson, 1987). This study reveals varied utilization and qualifications of ASP. The second study is a survey of a convenience sample of the membership of the professional organization that anesthesia support personnel may join voluntarily (American Society of Anesthesiology Technologists and Technicians). This organization offers a voluntary certification and membership for ASP seeking professional certification (American Society of Anesthesiology Technologists and Technicians, 2008a). This survey reveals wide variation in utilization and qualifications of ASP as well. Pharmacy technicians were cited as a group similar in scope, training and function to ASP. Review of relevant pharmacy technician literature revealed a process of professional evolution from which ASP may benefit. Present day pharmacy technicians are certified by a training board

to attest to their competency to practice. The present study is patterned after early literature in the field of pharmacy technicians and aims to provide an initial description of the population. This type of information had a significant impact on subsequent investigations and legislation regarding standardization of training and certification of pharmacy technicians. The proposed study parallels early pharmacy technician literature in scope and may offer the same implications for ASP. Given the important role of ASP in maintaining equipment and practice standards aimed at reduced anesthetic mortality, describing their training and utilization on a national scale is warranted.

Owing to the importance of anesthesia support personnel in contributing to patient safety and enhanced anesthetic operations, and the lack of literature describing this population, a prospective descriptive survey of the population was proposed. The present study proposed to describe the population of anesthesia technicians in terms of their educational characteristics and training, specific job functions and work environment. It further evaluates perceptions of practicing CRNAs regarding the utilization of ASP.

Overview of the Literature

Anesthesia support personnel (ASP) and pharmacy technicians found their origins in on-the-job training. Situated learning and communities of practice explain learning and subsequent role development that occurs in the context of social activity. These theories are also used to explain apprenticeships. However, situated learning and communities of practice refer to knowledge and practice development rather than the practitioner's placement in the formal structure. Pharmacy technicians practiced informally for a period of time. Pharmacy technicians have developed into a clearly defined group that is recognized formally through certification and state legislation. Due to the dearth of literature regarding ASP, pharmacy technician literature

was evaluated in the context of this evolution to provide an analogy that can be applied to ASP. The pharmacy literature cited in this study focuses on early work defining the role of pharmacy technicians because it is most comparable to the current status of ASP.

Situated Learning

The concept of "learning in practice" is described by situated learning theory, which proposes that cognition is embedded in activity. The interaction of persons and events in response to real problems promotes learning through action and problem solving. The theory contends that skill and knowledge are context based and therefore situated application reflects knowledge acquisition (Altalib, 2002). Situated learning consists of action, knowledge generation through action, social interaction, and complex situations (Stein, 1998). This theory can be applied to instructional design in creating programs and curricula that mimic situations in which specific interactions can promote knowledge acquisition (Altalib, 2002). Furthermore, reflection on aspects of situated events helps learners improve their understanding and knowledge (Orey & Nelson, 1994). Social aspects of community and culture that are embedded in the learning environment are central to this explanation of the learning process (Altalib, 2002).

Communities of Practice

Communities of practice describe the situation of membership within a community in which situated learning occurs (Altalib, 2002). They create a setting for the interactions in which learning becomes embedded (Stein, 1998). Lave and Wenger (1991) describe participation as an ongoing process of peripheral participation that becomes more involved as knowledge and experience within an area are increased. Wenger, McDermott, and Snyder (2002) further describe categories of participation within this learning community: peripheral, inbound, insider, boundary, and outbound. Peripheral refers to early learners who are just being exposed to the

group or situation. They have less performance expectations, but their participation is recognized as legitimate. Inbound represents those who have been accepted as potential group members. Insiders are those who are very familiar with the situation and process and may mentor inbound and peripheral participants. Boundary and outbound participants may be nongroup members who are interacting with the group in reference to a specific event or they may be moving away from the situation into another. These trajectories support the dynamic nature of the community. Communities of practice develop into groups that have jointly shared knowledge and culture that ascribe identity to the members (Wenger, 1996). As the communities become more clearly defined they can expand to include a broader social configuration and a global influence (Wenger, 1998).

Formal accountability of communities of practice. Situated learning and communities of practice explain knowledge acquired on-the-job (Lave & Wenger, 1991). A broad social configuration with global influence is further described (Wenger, 1998). However, situated learning and communities of practice do not entirely explain the division between informal and formalized work groups. The need for self-regulation in the context of an informal work group perpetuates communities of practice into formally organized professional groups. This results in delineated membership and an expectation of members. Owing to the limited amount of literature regarding ASP, pharmacy technicians were utilized as a group that could be comparatively evaluated in light of situated learning, communities of practice, and subsequent role formalization. Pharmacy technicians and ASP are similar in their role and evolution from on-the-job training to formally-trained and sanctioned practitioners. Pharmacy technicians are better established in this process and thus provide a good model for evaluating and understanding ASP. They are similar to ASP in that they both have a support role, a clearly defined supervisory

profession, and an organization that promotes certification as an indicator of proficiency. For these reasons and the paucity of ASP specific literature, the pharmacy technician literature was evaluated as a tool for understanding the context of the present ASP literature. Older pharmacy technician literature is presented because it is most comparable to the present situation of ASP.

Evolution of Pharmacy Technicians

The evolution of pharmacy technicians can be divided into two categories of literature. The early literature presents surrogate informants and offers general descriptions of practice, while more current literature offers modern practice descriptions as well as outcome comparisons between practice settings and educational backgrounds.

Early pharmacy technician literature. Early in the practice of pharmacy, it was recognized that the pharmacists needed an assistant to help with various technical tasks. Studies of this community of pharmacy assistant practitioners focused on describing this group in terms of their skills sets, knowledge and background. Often these studies utilized prospective, self-administered surveys of pharmacists or another better identified group who could describe the pharmacy technician population (Govern, Birdwell, & Sherrin, 1991; Hogan, 1985; Stolar, 1988; Thuo & Wertheimer, 1991a, 1991b, 1992). A 1985 survey of presidents of state pharmacy associations revealed that pharmacy technicians worked in every state (Hogan, 1985). Five of these states had outlined educational requirements. Surveys of hospital pharmacy services revealed similar findings, estimating 37,200 +/- 6,000 pharmacy technician positions nationwide (Stolar, 1988). Pharmacists registered with the Ohio State Board of Pharmacy reported that pharmacy technicians were utilized to varying degrees with a need for clarification of scope of practice and standardization of training (Govern et al., 1991). As the role became better defined, a study more directly targeted at pharmacy technicians could be undertaken. Thuo and

Wertheimer compared the competency, skills, and attitudes of pharmacy technicians who were recruited through 59 directors of pharmacy in Minnesota (Thuo & Wertheimer, 1991a, 1991b, 1991c, 1992). This study revealed that

formally-trained pharmacy technicians scored greater on a knowledge test and evaluation of competency by a pharmacist coworker (Thuo & Wertheimer, 1991c). These studies provided basic descriptive information that identified and described the target population allowing subsequently more refined work.

Current status of pharmacy technicians. Building on previous work, which clarified the role and scope of practice of pharmacy technicians, later studies were able to focus on specific aspects of practice and engage pharmacy technicians as direct participants in their studies. A convenience sample of pharmacy technician educators revealed that this group agreed that there should be a standard program training length, accreditation of training programs, and an entry-level examination (Moscou, 2000). A white paper endorsed by multiple pharmacy organizations echoed the need for uniform training standards, program accreditation, certification and state regulation (Rouse, Maine, Murer, Vlasses, & Zellmer, 2003). In 2005, the Pharmacy Technician Certification Board (PTCB) conducted a survey of 4,000 certified pharmacy technicians (CPhTs) for the purpose of updating their certification examination to make it reflective of pharmacy technician practice (Muenzen, Corrigan, Smith, & Rodrigue, 2005). These studies supporting standardization of training and delineating a curriculum would not have been possible without a clearly defined target population.

Anesthesia Support Personnel

The literature describing ASP utilization is limited to the findings of two survey-based studies. A survey describing this population in the setting of large urban anesthesiology

residency training programs was conducted in 1987 (McMahon & Thompson, 1987). The results of this study indicate that ASP are utilized to varying degrees and with varying backgrounds in the nation's anesthesiology training programs. Variable results across seemingly similar departments were noted. The average department had 6.6 technicians, or 1 technician per three operating rooms, and 2,000 annual cases with asymmetric distribution. The technicians in the sample included 83 high school graduates, 16 licensed practical nurses, 35 associate degree prepared individuals, 31 bachelors degree prepared individuals, and 28 registered nurses. The salary reported was commensurate with educational background.

Most of the supervisory responsibility for the support staff remained within the department of anesthesia (90%) (McMahon & Thompson, 1987). The vast majority of the respondents (97 [88%]) reported on-the-job training as the main vehicle for training their anesthesia technicians, while only 9 (8%) had received training in the military, and 4 (4%) had received formal training for this role. The responsibilities of the ASP described varied, but decreased in numbers as the task became more patient focused. Almost all departments reported that their technicians were responsible for cleaning equipment (97%). Many editorial comments expressing concerns regarding the level of training of their personnel and the desire for enhanced training were included in the responses to open-ended questions.

A second survey of a convenient sample of members of the professional organization, the American Society of Anesthesia Technologists and Technicians (ASATT) was published on the organization's website with limited contextual description (American Society of Anesthesiology Technologists and Technicians, 2008b). The ASATT offers certification as an "Anesthesia Technician" to ASP who have 2 years experience in an anesthesia support role and pass the certification examination. Although the technicians who were certified reported it was either a

requirement to maintain employment or was associated with benefits of increased pay and promotion, the majority of respondents were not certified (245 [58.19%]). The majority of respondents work at large private (120 [28.50%]) or teaching (148 [35.15%]) hospitals and report directly to the anesthesiology department (245 [58.19%]) or private anesthesiology group (10 [2.38%]) versus a nursing department (68 [16.15%]) or perioperative services (74 [17.58%]). The results for job responsibilities within the ASATT survey indicated that the majority of practicing anesthesia technicians (363 [86.22%]) assist with some combination of equipment management, workroom management, room turnover and supply stocking. Typical staffing ratios are 1 to 2 technicians per six operating rooms.

Rationale for the Study

Anesthesia support personnel serve in a role that has the potential to reduce anesthetic morbidity and mortality. They work in varying capacities to clean and maintain equipment that has become standard in the practice of anesthesia due to its enhanced patient safety. The role of ASP is clearly articulated and endorsed by respected professional organizations in anesthesia. The American Society of Anesthesiologists (ASA)/Anesthesiology Patient Safety Foundation (APSF) sanctioned pre-anesthesia checkout procedure has been revised in 2008 to include recommendations for the evaluation of the anesthesia machine preoperatively (Feldman, Olympio, Martin, & Striker, 2008). The pre-anesthesia checkout procedure, which is similar in scope to a preflight checklist used in aviation, includes a clear delineation of what tasks must be performed directly by the anesthesia provider and which of the tasks may be performed by an anesthesia technician. Information regarding the extent to which anesthesia technicians are utilized and educated nationally is virtually absent in the literature. The results of two studies available to describe the population present ASP usage and training that is highly variable

(McMahon & Thompson, 1987). For these reasons, a prospective study of ASP utilization on a national level is necessary to identify the education and training levels of those individuals functioning in this uniquely critical role.

Research Questions

The research questions to be evaluated through this investigation are:

1. What are the tasks that are delegated to ASP working with CRNAs as reported by CRNAs?

2. What are the educational backgrounds and anesthesia specific training of ASP working with CRNAs as reported by ASP supervisors?

3. To what degree is there a relationship between level of education of ASP reported by supervisor and CRNA level of comfort delegating tasks to ASP and between ASP level of education (as reported by supervisors) and CRNA perception of competency of ASP with whom they work?

4. What are the ratios of ASP per number of anesthetizing locations and case load? What is the relationship of these ratios to hospital size (as measured by case load, trauma level, annual case load, number of anesthetizing locations and suites)?

5. What is the relationship between practice size and CRNA level of comfort delegating tasks to certified ASP?

Definition of Terms

Terms relevant to the study include and are defined as follows:

Anesthesia provider. An individual who is trained and certified to administer anesthesia to a patient undergoing surgery.

Anesthesia support personnel (ASP). Any individual who assists an anesthesia provider with the logistic aspects of his/her job duties. Such assistance may include: setting up fluids or supplies for cases, changing out the disposables on the anesthesia machine and cleaning the anesthesia work area between surgical cases, bringing equipment or supplies to the room as needed during cases, and other duties as directed by the anesthesia provider.

Anesthesiologist. A direct provider of anesthesia who holds a medical degree and is board certified by the American Society of Anesthesiologist (ASA) to administer anesthesia or supervise another qualified provider who directly administers anesthesia.

Anesthesia assistant. A direct provider of anesthesia who holds an undergraduate degree in Biology or related science and a master's degree in Anesthesiology.

Certified registered nurse anesthetist (CRNA). A direct provider of anesthesia who has a bachelor's degree in Nursing, a master's degree in Nurse Anesthesia, and certification by the American Association of Nurse Anesthetists (AANA) to administer anesthesia.

Pharmacist. An individual licensed to dispense medications, consult patients, and supervise the activities of a pharmacy.

Pharmacy technician. An individual who assists with the activities related to dispensing medications within a pharmacy under the direction of a pharmacist. This individual engages in nonjudgmental tasks associated with pharmacy work.

CHAPTER 2. REVIEW OF LITERATURE

The review of literature relating to ASP is presented in five discreet sections. The initial sections present the theoretical framework of situated cognition and communities of practice. Situated cognition provides a theoretical explanation of problem-based, apprentice-style learning that is best aligned with on-the-job training and adult learning modalities (Altalib, 2002; Leonard, 2002; Stein, 1998). This describes the present state of ASP training in most hospital settings. Communities of practice further describe the delineation of core knowledge that is shared among groups who encounter common problems. Communities of practice explain the formation of groups engaged in the practice of providing support services to anesthesia departments. Communities of practice and situated cognition explain knowledge acquisition and transfer that occur in preprofessional and informal groups like ASP. The second section of this chapter reviews pharmacy technician literature. Pharmacy technicians and ASP both evolved from roles that were developed via on-the-job training. The intent is to present the literature that describes the evolution of a professional group that began as on-the-job trained, informal assistants. In the early 1970s to 1980s, pharmacy technicians functioned much like present day ASP. Their training, education, and job responsibilities were highly varied, but they were primarily trained on-the-job with responsibilities tailored to the needs of their work setting. As the profession of pharmacy technicians advanced, the practice became better described through studies presented in this literature review. Published literature in the field prompted professional

panels, and work to further define this group that ultimately contributed to a professional group with a formalized education and certification process. Pharmacy technician practice is well defined and developed at the present time. Examining the evolution of the pharmacy technician role offers an explanatory case study of how on-the-job trained roles become formalized and uniform. The last section presents the literature pertaining specifically to the field of ASP. The paucity of studies presented reflects the many gaps in knowledge regarding this population. These gaps further highlight the need to use pharmacy technicians as an analogous group. When the literature from these two groups is compared, the lack of a current description of ASP training, education and job responsibilities becomes glaringly absent. This review concludes with an outline of the gaps in the literature that remain regarding ASP.

Situated Learning Theory

Situated learning is a flexible and dynamic framework that stipulates a meaningful context is required in order for information to be constructed into knowledge by the learner (Altalib, 2002; Leonard, 2002; Stein, 1998). Situated learning is generally defined as learning that is influenced by the context and culture of the situation in which the learning is set (Leonard, 2002). This concept presupposes that learning is interactive, collaborative, and enhanced by a relevant context (Leonard, 2002; Wilson, 1993). Situated learning describes the integration of social, cultural and contextual tools into knowledge acquisition (Hansman & Wilson, 2002). Situated learning promotes authenticity in learning by framing knowledge in the context in which it is applied (Altalib, 2002; Leonard, 2002; Stein, 1998). This framework incorporates the cognitive, physical and social contexts that mediate action, reflecting learning as a sociocultural phenomenon (Altalib, 2002; Leonard, 2002; Stein, 1998). These aspects of situated learning are relevant in the setting of informal on-the-job learning.

Situated learning theory purports that skill and knowledge reflect the context of its acquisition and therefore its application (Altalib, 2002; Stein, 1998). In their research, Brown, Collins, and Duguid (1989) have established that learning cannot be separated from its context of acquisition or application; situations create knowledge through activity. Winn (1993) suggests that learning transfer occurs when learners solve authentic problems in a natural learning environment, in a similar fashion to what they might experience in a real-life work setting. Proponents of this theory extrapolate it to include human development as well. They argue that even individual human development and cognition are environmentally situated.

Situated learning has four major components: it is situated in everyday action, knowledge occurs through action within the situation, learning is a social process and requires interaction, and learning exists in complex settings (Stein, 1998). Knowledge is acquired through activity, and as such, learning is based on a problem-solving need. The learning structure and perception is embedded in the experience and culture (Merriam & Caffarella, 1999; Stein, 1998). In this manner, problem-based learning occurs in a realistic setting in which the learner interacts within the given situation. This coincides with Kolb's (1984) experiential learning theory.

Kolb's (1984) theory defines learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (p. 41). Experiental Learning Theory (ELT) presents dialectic constructs in a dynamic exchange—Concrete Experience (CE) versus Abstract Conceptualization (AC) and Reflective Observation (RO) versus Active Experimentation (AE). Tension is created among these four modes to create knowledge. This model is presented conceptually as a cycle of experiencing, reflecting, thinking, and acting. Concrete experience is

the basis of reflections and observations, which are distilled into abstract concepts to inform future action that will reinitiate the process.

The theory of situated cognition aptly guides instructional designers in their aim to create efficacious learning environments (Altalib, 2002). Herrington and Oliver (2000) offer nine key elements of the situated cognition framework that may serve as guidelines to instructors. They propose a content that is authentic and reflects the actual manner in which knowledge will be applied. Additionally, they suggest authentic activities, modeling by experts, provision of multiple perspectives, collaborative support, promotion of reflection, and articulation of situational resolution. These activities simulate the authentic environment in which problem-based learning and knowledge transfer occurs. They further recommend coaching and authentic assessment through evaluation of multiple indicators. In context, learning is attributed value that the learner reflects upon and incorporates in an appropriate way. It has been suggested that appropriate learning contexts include actual work environment, a surrogate environment, or a virtual situation via multimedia (Hansman & Wilson, 2002). The key requirement for these settings is that they offer an experience and promote reflection thus incorporating Kolb's (1984) phases of experiential learning—concrete experience and reflection (Atherton, 2009; Clark, 2004). It is then incumbent upon the learner to abstractly conceptualize and experiment with this new knowledge.

Schon (1983) contends that not only is learning situated in action, but that reflection on situated events helps learners/practitioners deal with difficult aspects of situations. Schon's emphasis on reflection is echoed in Kolb's experiential learning theory. Schon further suggests that practitioners engage in these reflective behaviors to cope and reframe the situation to

effectively solve problems. These behaviors correlate with Kolb's (1984) learning cycle of experience, reflection, abstract conceptualization and active experimentation.

A key component of context-based learning includes the social aspects of the learning interaction, particularly the values and culture specific to the community and environment (Altalib, 2002; Merriam & Caffarella, 1999). The main tenet of this theory is that learning does not occur in isolation from context, but rather is a result of the interaction within context (Wilson, 1993). The importance of authenticity of the learning experience is explained based on the significance of the social interaction of learning (Altalib, 2002; Orey & Nelson, 1994). As such, the social setting is an essential resource (Wenger, 1996). Authentic activities afford the participant an opportunity to engage socially with other participants within the learning environment (Altalib, 2002). It grants the learner a contextual "currency" for enhancing communication, participation, and belonging within the community of practice. Recognition of the social nature of learning allows the cognitive process of learning to be placed in the context in which it is experienced (Wenger, 1996).

Communities of Practice

Theoretical Definition of Communities of Practice

Communities of practice are explained within the framework of situated learning theory and exemplify the idea that learning occurs within a situation of membership (Altalib, 2002). These communities are dependent upon relationships that are collaborative, accepting, trusting and safe (Baker, Kolb, & Jensen, 2002). Lave and Wenger (1991) suggest that such communities extend beyond culture sharing, and that members have diverse interests, opinions and make unique contributions. Communities of practice have three main characteristics according to Barab and Duffy (2000). These include interdependence, a system of perpetuation, and common

historical heritage and culture (Altalib, 2002). Communities of practice do not necessarily consist of a well-defined and delineated group, but rather are fluid and include participants who share an understanding of activities within the context of their lives and communities (Altalib, 2002; Baker et al., 2002; Lave & Wenger, 1991; Wenger et al., 2002). Communities of practice provide a setting for interaction thus creating a situation in which learning can become embedded by providing an avenue for sharing knowledge with participants (Stein, 1998). Participation within the community is defined as active engagement of participants with one another in an effort to solve complex, dynamic situated problems (Stein, 1998). Driscoll (2000) contends that individuals may belong to multiple groups or practice communities with varying levels of participation.

Taxonomy of Participation Within Communities of Practice

Wenger et al. (2002) describes five categories of participation or learning trajectories within communities of practice: peripheral, inbound, insider, boundary, and outbound. The peripheral participant is not fully engaged, but rather participates peripherally, and may not ever choose to fully participate (Altalib, 2002; Wenger et al., 2002). The peripheral participant may be in the beginning stages of enculturation into the group as relationships with mentors and teachers are established (Orey & Nelson, 1994). Peripheral participants are recognized as not capable of full participation because of their level as novices, but remain members of the group nonetheless. The inbound participant is invested and seeks full participation (Altalib, 2002). The insider is committed and in a state of continuous evolution within the community. The boundary participant maintains membership in related communities and serves as a liaison between communities. The outbound participant is exiting the community.

Lave and Wenger (1991) describe peripheral participation as situated learning in which participants sometimes engage peripherally in communities of practice. Peripheral participation forms the beginning level of participation within the community (Altalib, 2002; Lave & Wenger, 1991). The second level of community of practice participation occurs as these newcomers progress to active participants (Altalib, 2002). Eventually, these active participants become old-timers, who are experts in their area and become influential in the instruction of newcomers. Cognitive apprenticeships are an excellent example of peripheral participant interaction with more experienced old-timers to confer skill and knowledge. The varying levels of participation explain the collaborative nature of group work particularly when group members are not approaching the learning situation from the same background. This is particularly the case when group members are teaching one another or engaged in the problem-solving activities that occur collectively in professions that are trained on-the-job through collaborative, group participation.

Development of Identity as a Practitioner

As people "develop a common practice, that is, shared ways of doing things and relating to one another that allow them to achieve their joint purpose . . . the resulting practice becomes a recognizable bond among those involved" (Wenger, 1996, p. 24). Membership in a given community becomes a part of the individual participant's core identity and knowledge base. Further participation within the community deepens the knowledge and level of personal integration. By linking membership to engagement and participation, communities of practice intrinsically generate boundaries between engaged participants and nonparticipants. These boundaries in turn become incorporated into member identities, which influence learning and knowledge construction and practice.

Formal Accountability of Communities of Practice

The concept of situated learning and the formation of communities of practice explain much about informal groups and learning that occurs across a variety of work settings and fields (Altalib, 2002; Merriam & Caffarella, 1999; Stein, 1998). The authors who propose these groups cite numerous exemplars in various professions, including midwives, tailors, quartermasters and butchers to support their theory (Lave & Wenger, 1991). They further articulate the process of formalization of these groups in a globally recognized way (Wenger, 1998). Since this process is group dependent, it is not as clearly developed. This is, of course, acceptable for an informal group, but lacks the clarity necessary to describe the process whereby new technical roles that correspond to technology changes are adapted into professionally credible and accountable fields. Understanding this process is particularly relevant in healthcare where technology is outpacing the development of a cohort of qualified technical professionals. A conceptualization of this process is necessary to frame the current study of ASP. Pharmacy technicians are presented as a group that is similar to ASP and can be analogized for the purposes of this research. The literature presented is somewhat older in order to offer a relevant context for framing the current study given the state of the field of ASP.

The process of self-regulation presents a challenge to an informal community characterized by various levels of participation. The first challenge includes determining who should be formally included in the group development. This requires identifying individuals who may or may not recognize their own membership. An individual outside of the group itself may identify the need to determine who is in the group. The initial steps of self-regulation may be initiated by members of a peripherally related group that is dependent on this informal community for service delivery. Ultimately the informal group becomes clearly identified. Once

this occurs, the process of role definition and clarification further identifies who is in the group and what level of formal participation is ascribed or assigned to that level of membership. Delineating membership assignments allows criteria to be established for membership. In most organizations of health care professionals, certification or licensure becomes the requirement for membership. As members become formally recognized through certification or licensure, standards of practice are developed to set the expectation for the performance of certified or licensed individuals. This progression marks the transformation of an informal community of practice into a formalized professional organization and is evidenced in the pharmacy technician literature that follows.

The remainder of this review presents early pharmacy technician literature. This literature is taken from the late 1980s and early 1990s because this is the time period during which pharmacy technicians most closely resembled ASP in terms of their role definition. The early pharmacy technician literature reflects the informally acknowledged, preprofessional state of this group. This early literature can almost be sequenced chronologically by publication date to reveal this evolution. Initial studies defined who comprised the group with subsequent studies describing the nature of their work or use. Later studies described skills and training from the perspective of pharmacy technicians themselves and from the perceptions of supervisors and co-workers. Following the early pharmacy technician literature, the current status of pharmacy technicians is presented. The literature in this section demonstrates perceptions of educators and supports formalization and standardization of training, education, scope of practice and certification. This section also includes a study on current practice of pharmacy technicians conducted by the certifying board and used to determine appropriateness of topics on the certifying exam. After the pharmacy technician literature, the current literature on ASP is

offered. The last section presents a synthesis of these reviews and concludes with the gaps in ASP literature highlighted against the template of pharmacy technician literature.

A review of the literature on pharmacy technicians revealed many similarities to what is known about the population of ASP. Both groups evolved to facilitate delivery of professional healthcare services. On-the-job training was initially the primary training for the role in both cases. Pharmacy technicians and ASP are represented by a professional organization that encourages and facilitates a certification process, although the ASP process is much less uniform (American Society of Anesthesiology Technologists and Technicians). These characteristics make pharmacy technician literature relevant to an understanding of the emerging formalization of ASP as a professional group.

Evolution of Pharmacy Technicians

Early Pharmacy Technician Literature

As early as the 1940s, it was recognized that pharmacists needed some form of assistant to perform various technical tasks in the work of the pharmacy. It was generally agreed that this individual would not replace the pharmacist, but rather would free him/her to perform tasks that required the advanced knowledge and expertise that only a pharmacist possessed. In this way the work in the pharmacy was hierarchically assigned to maximize resources and achieve efficiency of personnel. The practice of using pharmacy technicians became commonplace but not uniform. Pharmacy technicians were not utilized in the same way or to the same degree in all pharmacies. This prompted a series of studies within the community to evaluate existing pharmacy technicians in terms of their education, background, role, scope of practice and perception by peers and supervisors (Govern et al., 1991; Hogan, 1985; Stolar, 1988). As questions arose about the appropriateness of certain tasks and the qualifications necessary to serve in this role, a body

of literature began to develop to address these concerns. Several prospective self-administered surveys were conducted focusing on issues of role definition, education, scope of practice and perception by pharmacists and supervisors (Govern et al., 1991; Hogan, 1985; Stolar, 1988; Thuo & Wertheimer, 1991a, 1991b, 1992).

These early studies evaluated pharmacy technicians from the perspective of professionals experienced in working with this group such as pharmacists and supervisors. This was particularly useful given the fact that no professional organization yet existed to provide direct access to this population. The presidents of the 49 affiliated state chapters of the American Society of Hospital Pharmacists (ASHP) were surveyed in 1985 (Hogan) for the purpose of describing technician use from the perspective of persons familiar with common practices in a given state. This study was delimited by reliance solely on the perceptions of the presidents of the states' pharmacy associations. Findings might have been enhanced by a concomitant document analysis of state legislation; however, the study provides sound evidence for a description of pharmacy technician services on a national scale stratified at the state level.

The results indicated that pharmacy technicians were utilized in every state and were allowed to work in community pharmacies in all but eight of the states (Hogan, 1985). From a previous study in 1981, an additional five states had permitted technicians to work in community pharmacies. Five states had implemented educational requirements. These requirements included high school education in Louisiana, Nevada, and Washington, and were elaborated to include in-service training in Arkansas, and documentation of on-the-job training in Kansas. Of the states surveyed, one-third proscribed ratios of pharmacy technicians to supervising pharmacists with varying degrees of supervision required. Pharmacy technicians were found to perform varied nonjudgmental tasks, such as stocking, inventory management, and dispensing under a

pharmacist's supervision throughout the United States. At the time of this survey, pharmacy technician use was prevalent, but a clear definition of their scope of practice was absent in many states.

Information describing the utilization of pharmacy technicians is also found through surveys of hospitals regarding pharmacy services. Stolar (1988) sent self-administered surveys to 875 randomly selected hospitals from the 5,600 short-term hospitals employing pharmacists in the United States. The author's goal was to describe their pharmaceutical services. This survey was conducted to evaluate general pharmacy services in short-term hospitals to the exclusion of federal and long-term facilities. While some potential sources of sampling error were identified, none of them impacted findings relevant to pharmacy technicians. Findings revealed that at the time of this study, hospitals had an average 2.7 full-time positions vacant (open, but unfilled positions) with a small range based on size—2.7 in small hospitals, 2.9 in medium hospitals, and 2.1 in large hospitals. There were a projected 37,200 +/- 6,000 pharmacy technician positions in the United States. Of the 1,336 pharmacy technician FTEs represented by the survey, 33.6% were formally trained. When evaluated by size of hospital, pharmacy technicians were formally trained at 23.3% of small hospitals, 32.5% of medium hospitals, and 49.1% of large hospitals. Pharmacy technicians in 23.0% of for-profit hospitals versus 34.9% of nonprofit hospitals were formally trained, while 27.2% of multisystem versus 38.4% in independent hospitals were formally trained.

Pharmacists working with pharmacy technicians are another group that provided useful information regarding this population. This information is useful because pharmacists are in a position to evaluate the functioning of the pharmacy technicians. A prospective questionnaire was sent to 356 hospital pharmacists registered with the Ohio State Board of Pharmacy (Govern

et al., 1991). This questionnaire included items regarding use, regulation, training and certification of pharmacy technicians as well as 32 functions for respondents to distinguish as currently performed by technicians and appropriate to be performed by the technician. The instrument also included 16 attitudinal statements concerning the pharmacist role, function and training of technicians, supervision, impact of future technology and job displacement concerns. The instrument included items that exhibited face validity and were consistent with other similar surveys. The overall goal of this survey was to describe hospital pharmacists' attitudes toward pharmacy technician responsibility, training, certification, and licensure and potential to displace practicing pharmacists. One delimitation of the study was that the sample of pharmacists was limited to the state of Ohio. At the time of the study, Ohio had no pharmacy technician regulation. Additionally, the response rate of 51% leaves the possibility of nonresponse bias. Of the 182 pharmacist respondents, 83% possessed a bachelor's degree only, and 17% post bachelors degree (primarily M.S.) (Govern et al., 1991). The respondents had an average 10.8 years of practice experience, and 98% (179) worked for a hospital that employed pharmacy technicians. The mean hospital size was 390.7 beds (ranging from 40-1,200 beds), and 90% offered unit dose/admixture services, 83% centralized services, 32% decentralized services. Urban hospitals employed 51.7% of the respondents, while 32.8% worked in suburban and 15.4% in rural settings.

There was general agreement that the pharmacy technician scope of practice should be more clearly defined, that technician use increases pharmacy efficiency, and that "most distributive functions can be delegated" (Govern et al., 1991, p. 1231). They disagreed that future technology would replace technicians. "The respondents agreed that all pharmacy technicians should receive standardized training and education and that career ladders should be

developed for technicians" (Govern et al., 1991, p. 1231). These pharmacists believed that the most effective training was an accredited hospital-based training program. They recommended a mean length of 10.3 months (ranging from 1-48 months). Seventy-seven (42.3%) believed pharmacy technicians should be certified, 50 (27.5%) licensed, 32 (17.6%) neither, and 23 (12.6%) were undecided. A majority, 102 (56%), felt that pharmacy technicians' functions should be determined by individual department policies and procedures. Certain functions were more likely to be performed by technicians at larger hospitals. These included math calculations, reconstitution of drugs, compounding topical preparations, packaging and labeling dose unit doses of oral liquids and solids, packaging and labeling unit doses of injectable solutions; filling patient medication bins; preparing intravenous antimicrobials, preparing total parenteral nutrition and auditing controlled substances. Pharmacy technicians at central city hospitals were more likely than suburban or rural technicians to perform math calculations, drug reconstitution, packaging and labeling unit doses of injectable solutions, preparation of large-volume injectable solutions, compounding topical preparations and maintenance of emergency carts.

There is extensive use of technicians with responsibilities varying by hospital size and location (Govern et al., 1991). Of the suggested functions to be performed by the technicians, 16 were agreed appropriate by greater than 50% of the respondents; 12 of the functions were more likely to be performed in hospitals as bed size increased; and 4 were considered inappropriate for technicians. Functions felt to be inappropriate included accepting verbal orders, verifying appropriateness of an order, verifying accuracy of patient medication bins and providing drug information. The pharmacists preferred a formalized training program and a high level of training. They also preferred certification or licensure, but gave greater preference to certification. These pharmacists did not seem to perceive pharmacy technicians as a job threat.

Education level, number of years employed in the pharmacy, and current position of the respondent had the greatest effect on the respondents' perception of the "appropriateness of having technicians perform some functions currently or in the future" (Govern et al., 1991, p. 1231). The authors concluded that the perceptions of Ohio pharmacists were consistent with the perceptions and practices in the field of pharmacy nationally.

As the literature base has developed, inquiries targeted more directly at pharmacy technicians, as defined by the ASHP, could be undertaken because a clear study group had been delineated. A sample of 502 pharmacy technicians was identified based on the technicians' employment in institutional health care settings in Minnesota (Thuo & Wertheimer, 1991b). These pharmacy technicians were recruited through directors of 59 institutions. This prospective, quasi-experimental survey was designed to compare formally-trained technicians (FTTs) with on-the-job trained technicians (OJTTs). This 2-part survey was completed by technician and supervisor, respectively. The first part included demographic questions, a cognitive test, and an affective questionnaire to illicit attitudes and feelings. The second part consisted of a 10-point rating scale from "very poor" to "exceptional" evaluating competencies set forth by the ASHP, the accrediting agency. This survey was limited to pharmacy technicians practicing in Minnesota. The study was further limited by the fact that the majority of the FTTs were trained at a single institution—Northeast Metro Technical College—however, at the time of the study there were few schools providing formal training for pharmacy technicians. This may have limited the generalizability but not the validity of these findings. This survey aimed to evaluate the hypothesis that FTTs are more competent than OJTTs in cognitive proficiency, skill and general proficiency/competency. The authors further hypothesized that level of training is the best predictor of performance in these domains.

Cognitive, skill, and overall competency scores were higher for FTTs (Thuo & Wertheimer, 1991c, 1992). Training explained most of the variability in cognitive scores. Experience explained most of the variability in skill scores. Training followed by experience was most predictive of overall competency score. Formal training for pharmacy technicians was favored by both groups, although to a greater extent among the FTTs (71.2%) versus 52.1% of OJTTs. Although not statistically significant, slightly more FTTs (75%) than OJTTs (62.6%) felt proficiency would be increased by formal training. The majority of pharmacy technicians of both training types (FTTs–83.7%; OJTTs–71.8%) agreed that any evaluation of technician competency should include knowledge and skill components. The majority of technicians (FTTs–78.8%; OJTTs–69.4%) also believed competency should be recognized by licensure or certification. The majority of FTTs (66.3%) and a significant number of OJTTs (47.4%) felt that technician opportunity should be contingent on successful completion of competency examinations.

Formal training programs for pharmacy technicians appear to yield the most overall competent pharmacy technicians. Pharmacy technicians trained via both the on-the-job and formal method indicate that formal training is preferable for this role. Furthermore, technicians agree that certification or licensure by examination is the preferred mode of recognition for competency in this field.

The overarching theme of these early inquiries into the utilization and role of pharmacy technicians is a need for a clear group and role definition. The lack of definition forced early studies to seek access via information surrogates. In the review presented here, these surrogates included presidents of state pharmacy associations (Hogan, 1985), practicing pharmacists registered with the state's board of pharmacy (Govern et al., 1991), pharmacy services surveys

(Stolar, 1988) and recruitment through institutional directors (Thuo & Wertheimer, 1991b, 1991c, 1992). For these same reasons, these studies by necessity were limited to primarily quantitative, prospective surveys with a descriptive focus. Once clear definitions and descriptions were credibly established for these groups, further work could be more clearly defined in terms of sample, hypothesis and overall focus.

Current Status of Pharmacy Technicians

Descriptive work to provide role definition and scope of practice clarification preceded and provided impetus for national level actions that further perpetuated this body of knowledge. Skill sets necessary for the role of pharmacy technicians were identified, increasing numbers of pharmacy technicians became certified and professional organizations emerged. These organizations and clarified constructs provided a source for further research and refinement of the descriptions set forth in earlier inquiries.

As this field developed, a group of educators emerged to share their perspective. A convenience sample of 130 members of the Pharmacy Technician Educators Council (PTEC) was sought to determine attitudes towards pharmacy technician education level and training requisite for current and advanced duties (Moscou, 2000). The 37 respondents from 19 states comprised a 28.5% response rate. A weakness of the inquiry was a reliance on a convenience sample with only 19 states represented and a low response rate. Although untested, the survey instrument exhibited appropriate face validity with the exclusion of one question requiring some interpretation about on-the-job training versus hands-on learning. In spite of the low response rate and survey concerns, the face validity is such that the conclusions remain credible and supported by the existing body of literature.

Pharmacy technician educators were in consensus that there should be a standard training length; opinions varied on how long, but the majority recommended 1 year (Moscou, 2000). The respondents preferred formal vocational/college training to on-the-job training. All agreed that programs should be accredited, but were in disagreement about what agency (50% TEC/minority ASHP). The majority (94%) believed technicians should have documentation of competency through licensure or certification (50%), licensure alone (29%), or certification alone (12.5%). They were completely agreed on the need for pharmacy technicians to pass an examination prior to entering practice. Overall, these authors concluded that there is a standardized approach to pharmacy technician training including length and curriculum is needed to ensure training levels are commensurate with job duties and expectations.

In 2003, a white paper was published that was endorsed by multiple pharmacy groups including the American College of Apothecaries, American College of Clinical Pharmacy, American Council of Pharmaceutical Education, American Pharmaceutical Association, American Society of Health-System Pharmacists, etc. (Rouse et al., 2003). Given the extent of these endorsements, this document reflects the sentiment within the field regarding pharmacy technician use. The goal of the paper was to present issues that need to be addressed in the effort to develop and maintain an adequate and competent work force of pharmacy technicians. This paper presented the need for uniformity in training and education, program accreditation, certification and state regulation as the key issues remaining to be addressed. These authors define a pharmacy technician as "an individual working in a pharmacy [setting] who, under the supervision of a licensed pharmacist, assists in pharmacy activities that do not require the professional judgment of a pharmacist" (Rouse et al., 2003, p. 38). The technician is a part of a larger category of "supportive personnel," a term used to describe all nonpharmacist pharmacy

personnel (Rouse et al., 2003, p. 38). The authors recognized that there had been role expansion, clarification of scope of practice, and the availability of a certification exam. However, there still exists diversity in entry requirements for this profession. National training and certification standards are needed to address these issues. At the time of this publication, there were an estimated 250,000 pharmacy technicians practicing in the United States fulfilling the duties of dispensing, administration and inventory management. Demand is expected to increase in the near future due to a predicted shortage in pharmacists, increased demand for pharmacy services attributable to population aging, and increased attention focused on medication safety. These authors advocate further refinement of educational standards, program accreditation, certification of technicians and regulatory statutes to maintain an adequate workforce to meet future demands.

Even though certification was not uniform, by 2005 there was substantial use of a single certification organization (Muenzen et al., 2005). The Pharmacy Technician Certification Board (PTCB) has created and conducted the Pharmacy Technician Certification Examination (PTCE) since 1995 to confer Certified Pharmacy Technician (CPhT) status. In order to maintain current certification examination procedures, the PTCB conducted a prospective web-based survey using mixed-methods including open-ended questions regarding quality assurance. The PTCB sought to identify current trends in pharmacy technician practice to ensure validity, reliability and relevance of the PTCE. Using a stratified random sample of 4,000 certified pharmacy technicians (CPhTs), they obtained a 26% response rate. To evaluate sampling error the authors conducted a subsequent nonrespondent survey.

The survey revealed that CPhTs are employed in community pharmacies (50%), hospitals (33%), and other locations (17%) such as ambulatory care centers, long-term care facilities, home health, mail-services, managed care and the military (Muenzen et al., 2005). They assist

pharmacists (63%), maintain inventory and medication control systems (23%), and practice management/administration (17%). These results were similar to a 1999 study in terms of variety of task breakdown by employment type. However, the current findings revealed advancement in responsibilities and expanded role. These expanded tasks included quality assurance roles including order entry verification, redundant medication checks, screening for similarly abbreviated medications, separation of Sound-Alike, Look-Alike (SALAD) medications and continuing education. There has been an increased role of CPhTs in supervisory responsibilities 40% versus 32% in 1999. Additionally, there is an increased number of formal on-the-job training provided by employer (40% versus 29% in 1999). This survey was limited to CPhTs to the exclusion of noncertified technicians. Certified pharmacy technicians' roles and responsibilities are expanding and as such the content outline for the PTCE will be revised based on the findings of these authors.

The conclusion of the literature describing the professionalization of pharmacy technicians describes a survey of tasks performed by technicians to inform a standardized certification exam. This was made possible by the previous studies that impacted the professional development of pharmacy technicians. Early studies described the population from the perspective of defined and therefore accessible populations such as pharmacists and supervisors. Once the population was well defined, their education and training could be further described in the context of their job function and employment type. From that point, research began to evaluate perspectives of pharmacists, pharmacy technician educators, supervisors and pharmacy technicians themselves regarding the needs of the group. The results of these inquiries informed the work of professional organizations leading to standardization of training and certification

requirements. Presently, research in this area emphasizes current practices to inform future iterations of the requirements for entry into this professional group.

Current Status of Anesthesia Support Personnel

Descriptive surveys of anesthesia support personnel are limited in the literature. A definition of this role and scope of practice is absent as well. Similar to pharmacy technicians, this group needs to be described so that group definition and appropriateness of role can be established. Owing to the variability with which ASP are thought to be utilized in mainstream anesthesia practice, there remain limitations in gaining access to this group. There is one study in the literature describing ASP. Like early studies evaluating pharmacy technicians, it relies on a surrogate respondent to answer questions about the utilization of personnel in a support role. In addition to this published study, the website of the ASATT contains the results a convenient survey of their membership. It is highly limited by self-selection; and it possibly overlooks potential practitioners who are not members of this organization. However, it provides information that may be relevant to future inquiries if taken in context.

McMahon and Thompson (1987) described ASP usage within a sample of 173 residency-training programs. A survey was sent to the chairperson of each of these teaching departments. The instrument included questions designed to obtain descriptive information about the definition, role, responsibilities, background and training of the ASP within that department. Of the 173 members of the sample, 112 (65%) responded. This study was delimited by the restriction of sampling to teaching hospitals excluding the broader population of community and nonacademic hospitals. A limitation of the study was the lack of a clear definition regarding ASP that led to some instances of inconsistency using the instrument. However, the overall instrument

design demonstrated face validity for the topic and was appropriate to this level of exploratory inquiry.

Anesthesia support was utilized to varying degrees in the settings surveyed (McMahon & Thompson, 1987). There were variable results across seemingly similar departments. The average department had 6.6 technicians with asymmetric distribution. There was an average ration of one technician per three operating rooms and 2,000 annual cases. The technicians reported on in the sample included 83 high school graduates, 16 licensed practical nurses, 35 associate degree prepared individuals, 31 bachelor's degree prepared individuals, and 28 registered nurses. The salary reported was commensurate with educational background. High school graduates earned an average $25,000 per year, licensed practical nurses $30,000 per year, 2-year college $35,000 per year, 4-year college $ 37,000 per year and registered nurses $42,000 per year.

Most of the supervisory responsibility for the support staff remained within the department of anesthesia (90%) (McMahon & Thompson, 1987). A staff anesthesiologist was responsible for the support staff in 51% of the responding hospitals. A CRNA performed supervisory role 23% of the time, while an operating room supervisor (2%) or "other" (24%) performed this role in the remaining institutions. The vast majority of the respondents (97 [88%]) reported on-the-job training as the main vehicle for training their anesthesia technicians, while only 9 (8%) had received training in the military, and 4 (4%) had received formal training for this role. Many editorial comments expressing concerns regarding the level of training of their personnel and the desire for enhanced training were included in the responses.

The responsibilities of the ASP described varied, but decreased in number as the task became more patient focused (McMahon & Thompson, 1987). This may reflect on and

substantiate the editorial comments by the department chairmen expressing concerns regarding their technicians' qualifications. Almost all departments reported that their technicians were responsible for cleaning equipment (97%). Monitor set-up and calibration was a technician responsibility in 80% of departments. Machine maintenance was performed by technicians in 67% of departments, while only 35% expected technicians to determine blood gases. Almost none of the departments surveyed had technicians who prepared drugs (3%), while 6% reported arterial line insertion as a technician role. Starting intravenous lines was a function of the technician in 14% of the departments.

The American Society of Anesthesia Technologists and Technicians (2008b) conducted a survey of their membership using a sample of convenience. The ASATT offers certification as an Anesthesia Technician to ASP who have 2 years experience in an anesthesia support role and pass the certification examination. Although the technicians who were certified reported benefits of increased pay, promotion and requirement to maintain employment, the majority of respondents were not certified (245 [58.19%]). Of those certified, 87 (49.43%) reported an increase in pay, 43 (24.43%) reported a promotion, 44 (25%) reported certification as a requirement to maintain employment, and 61 (34.66%) reported no benefit. The majority of respondents worked at large private (120 [28.50%]) or teaching (148 [35.15%]) hospitals and reported directly to the anesthesiology department (245 [58.19%]) or private anesthesiology group (10 [2.38%]) versus a nursing department (68 [16.15%]) or perioperative services (74 [17.58%]).

The results for job responsibilities within the ASATT survey indicated that the majority of practicing anesthesia technicians (363 [86.22%]) assisted with some combination of

equipment management, workroom management, room turnover and supply stocking. Specific tasks included ordering supplies (361 [85.75%]), assisting with difficult intubations (372 [88.36%]), conducting room turnovers (377 [89.55%]), assisting with patient transport (262 [62.23%]), assisting with blood warming equipment (386 [91.69%]), and troubleshooting anesthesia machines (388 [92.16%]). These anesthesia technicians typically worked in all areas where anesthesia is administered (214 [50.83%]), while some worked in specific areas including the operating room (173 [41.09%]), labor and delivery (5 [1.19%]), pain clinic (1 [0.24%]), and radiology (4 [0.95%]). Typical staffing ratios were 1 to 2 technicians per six operating rooms.

The ASATT survey was limited by the sampling method of convenience, which limited generalization to the larger population. Additionally, the survey results were presented on the organization's website with no information regarding how or when the results were obtained.

Synthesis

The initial education of pharmacy technicians and ASP appears to have been through informal on-the-job training. The theoretical framework supporting this type of learning is situated learning theory, which presupposes that this knowledge acquisition is situated in the activity—the act of assisting in either a pharmacy or anesthesia department. The literature on communities of practice supports the development of discreet cohorts with a body of knowledge constructed and shared by group members. The pharmacy technician literature provides an outline of the movement from informal groups to a recognized identifiable profession. This is first documented by early pharmacy technician descriptive studies depicting the role and qualifications of pharmacy technicians. These initial studies relied on identifiable groups to provide information regarding pharmacy technicians. These groups include presidents of state pharmacy associations, hospitals providing information on pharmacy services, pharmacists

working with pharmacy technicians with access to the population to describe the pharmacy technicians who at that time had limited role definition and accessibility. As the role became better defined, studies to describe the population using survey methods of pharmacy technicians themselves were undertaken. This work included demographic, educational, and attitudinal descriptions. In some studies, responses of pharmacy technicians were paired with the pharmacists with whom they work to reveal the pharmacist's perceptions of competency of the technician with those perceptions compared to educational and training background. As a well-defined profession emerged, subsequent studies focused on perceptions of pharmacy technician educators describing their views on what should be standards for pharmacy technician education. In 2005, the PTCB Certification Board conducted a survey of CPhTs to identify current trends in practice for the purpose of validating their certifying examination. This group of research clearly outlines the transition of pharmacy technicians from an informal, unrecognized community of practitioners to an organized profession that uses information provided by its membership to inform future education practices and exam validation. This transition has had many benefits both within the profession and to the public including the ability to monitor and evaluate patient safety outcomes of this group. This sequential transition offers a comparison for ASP who currently exist at the level of an informal community of practitioners. Using the pharmacy technician transition to recognized practice as a model for ASP will likely afford the same benefits of enhanced safety and competency evaluation.

The ASP literature is currently at the level of development of the early pharmacy technician inquiries. This community has a limited definition that unto itself presents difficulties directly accessing the population. Presently the two studies that exist describe the population

incompletely. The study by McMahon and Thompson (1987) describes ASP utilization at academic medical centers only. The 2004 member survey by the ASATT represents only a self-selected group of members. Regarding the community of practice of ASP, there remains a gap in the literature in terms of their description and perception by related practitioners. When analogized to pharmacy technicians, ASP are presently practicing at a nonuniform, informal level in the national context. In order to better understand the needs of this population, this gap must be addressed by providing a description of ASP, an assessment of their knowledge, training, and competency related to current practice, and an evaluation of the perceived safety they contribute to anesthesia delivery. The purpose of this study was to present a descriptive foundation of ASP that future studies will build on to realize the potential safety and quality benefits afforded by professionalism.

CHAPTER 3. METHODS

This chapter begins with an introduction of the current utilization of ASP and their analogous evolution to pharmacy technicians. The research questions are presented followed by a description of the design and sample that will include membership of the AANA. The development process of the survey measure is then presented including explanation of variables. The pilot study intended to establish the validity and reliability of the survey instrument is then presented. The chapter concludes with a description of the proposed data collection procedures.

Introduction

This study was intended to explore ASP utilization in the practice of anesthesia in the United States. There is limited information regarding the utilization, training and scope of practicing ASP within the context of anesthesia practice. Since ASP are functioning in some practice settings to ready and maintain life-saving equipment that is critical to patient safety, it seems important to understand the skills and training to describe the population acting in this role. Pharmacy technicians have been identified as a group who serve a similar role with a well-defined supervisory group. Pharmacy technicians presently are certified by a national certifying board following studies to identify and clarify this role. The pharmacy literature was used as a guide for the present inquiry. The literature cited is framed in a comparative professional context parallel to the present situation of ASP. Many of these studies were conducted in the 1980s and 1990s and supported the transition of the pharmacy technician role

from on-the-job training to a professionally organized and certified group. Similar to the data development processes used with pharmacy technicians, a descriptive, correlational survey design was proposed using a researcher-designed survey tool to describe the ASP population. The specific questions addressed are as follows.

Research Questions

1. What are the tasks that are delegated to ASP working with CRNAs as reported by CRNAs?

2. What are the educational backgrounds and anesthesia specific training of ASP working with CRNAs as reported by ASP supervisors?

3. To what degree is there a relationship between level of education of ASP reported by supervisor and CRNA level of comfort delegating tasks to ASP, and between ASP level of education (as reported by supervisors) and CRNA perception of competency of ASP with whom they work?

4. What are the ratios of ASP per number of anesthetizing locations and case load? What is the relationship of these ratios to hospital size (as measured by case load, trauma level, annual case load, number of anesthetizing locations and suites)?

5. What is the relationship between practice size and CRNA level of comfort delegating tasks to certified ASP?

Design

A descriptive, correlational design employing survey methods was proposed to answer these questions.

Sample

A random sample of $N = 2,500$ was selected from the AANA membership roster by the AANA. Ninety-eight percent of all practicing CRNAs are members of this organization; as such, this random sample was likely to reflect the population. Of the membership who responded to the 2007 AANA membership survey, 81.1% were employed full time; 14.4% were employed part time; 3.4% were retired; and 1.1% was unemployed (American Association of Nurse Anesthetists, 2008b). The make up of the group included some representation of most major races including American Indian (0.5%), Asian/Pacific Islander (2.7%), Black/African American (2.4%), and Hispanic (1.7%) although the majority was White/Caucasian (91.7%). The majority of the responding full and part-time employed CRNAs practiced in urban settings (82%) versus rural settings (18%). The respondents were 56.3% female and 43.7% male. Median age of the group was 50 years; mean age was 48.4 years.

The introductory e-mail for this study included instructions for the primary recipient to forward the e-mail to the ASP supervisor in his/her area. The ASP supervisor population was unknown. The introductory e-mail contained instructions for the CRNA and ASP supervisor, and both entered the same survey. The participants were directed to questions as appropriate based on prior responses. Additionally, the CRNA entered a self-created code in the forwarded e-mail subject line that linked the two respondents. Both respondents then entered the code in response to the second question of the survey.

Measures

The survey was designed by the researcher in two phases. The items were designed and evaluated for face validity. Then the entire survey was pilot tested to evaluate its internal structure.

Development of the Survey

The literature describing ASP utilization is limited to two existing surveys. A survey describing this population in the setting of large urban anesthesiology residency training programs was conducted in 1987 (McMahon & Thompson, 1987). A second survey of members of the professional organization, the American Society of Anesthesia Technologists and Technicians (ASATT), was published on the organization's website with limited contextual description. Therefore, a study of the utilization of ASP on a national level is relevant and appropriate in the context of such limited previous work. Owing to the limitations of prior studies specific to ASP, pharmacy technician literature was evaluated to provide guidance for research in the related field of ASP.

A review of the literature on pharmacy technicians revealed many similarities to what is known about the population of ASP. Both groups evolved to facilitate delivery of professional healthcare services. On-the-job training was initially the primary training for the role in both cases. Pharmacy technicians and ASP are represented by a professional organization that encourages and facilitates a certification process. These characteristics make pharmacy technician literature relevant to the development of an instrument to describe and measure perception regarding ASP utilization.

A pool of survey questions focused on the description of anesthesia technician utilization, perceptions of usefulness, and comfort level with delegation of tasks was generated. The questions were designed to either directly assess a given variable or serve as part of a scale to assess the overall constructs of CRNA perceived competence of ASP with whom they work, and CRNA perception of safety enhancement assuming ASP were available. These were identified as constructs that would measure CRNA perception of the nontangible value of safety that the ASP

added to the patient care environment. No previous operational definition of ASP exists in the ASP specific literature or in the community of respondents. These constructs were derived from similar constructs in the early literature evaluating pharmacy technicians. Questions were framed in a way to create a scalable response that is likely to correlate with the degree of confidence the individual perceives regarding the constructs. For example, more CRNAs perceiving availability of licensed anesthesia technicians to correspond with enhanced safety would *strongly agree* with the statement: "The ability to delegate tasks such as assisting with difficult intubations, assisting with insertion of invasive lines, and initiating intravenous access to licensed anesthesia technicians would enhance patient safety."

This question bank and operational definitions of the constructs were reviewed by experts in the field of nurse anesthesia for readability, comprehensibility and clarity. This expert panel consisted of three nurse anesthetists with 5, 15, and over 30 years of experience. All members of the panel work in a Level I trauma center within a large university affiliated hospital. They frequently work with students, give lectures, and function as both educators and clinical practitioners. Questions were revised following the recommendations of these reviewers.

Structure of the survey. The development of the survey instrument for the study relied on the existing body of literature in the fields of pharmacy technicians and ASP. Relevant previous findings impacted question and construct development. Competency scores, as measured by pharmacists with whom pharmacy technicians worked, were higher with an increased level of background education and formal versus on-the-job training for the role (Thuo & Wertheimer, 1991a). Pharmacy technician educators and practicing pharmacists indicated a strong preference for pharmacy technician training to be standardized nationally, preferably in the form of formalized training programs leading to certification (Govern et al., 1991).

Pharmacists agreed that the pharmacy technician role needed further clarification but believed these individuals could enhance quality and efficiency of service delivery (Govern et al., 1991). The pharmacy literature provides evidence to support the validity of the proposed hypotheses and the variables measured within the instrument.

All variables measured on the survey instrument are listed and operationally defined in Table 1. These variables are relevant because they provide a description of the department in the context of its resources and ASP utilization in a way that can be compared to CRNA perception. The perception measures are relevant because they measure confidence and perception of safety as surrogate indicators of the effectiveness of the anesthesia technicians. This assortment of variables enables an evaluation of the utilization matrix of ASP that practicing CRNAs would perceive as most beneficial.

Explanation of Variables

The trauma level designation of the primary practice setting provides an indication of the resources immediately available within the institution to meet the needs of complicated trauma. Trauma level is a surrogate indicator of the resources of the population served. Information on federal funding for specific services is available based on trauma designation. It is hypothesized that trauma designation will be inversely correlated with constructs of confidence and perception of safety of certified or licensed anesthesia technicians. This hypothesis is based on the

Table 1

Operational Definition of Variables

Variable	Operational Definition
Trauma level	The trauma response level indicates the resources immediately available within the institution to meet the needs of complicated trauma (CRNA respondents).
Designation of primary practice setting	The number of different grouped locations where anesthesia is performed (i.e., main operating room, ambulatory surgery suite, dental clinic, endoscopy suite). These locations may have multiple suites grouped together.
Number of anesthetizing locations	This number refers to the collective number of different areas (CRNA respondents).
Number of anesthetizing suites	The total number of operating rooms, procedure rooms, or other suites where anesthesia may be performed in the respondents' primary practice settings (CRNA respondents).
Number of direct anesthesia care providers	The number of anesthesia providers who directly administer anesthesia in the operating room (CRNA respondents).
Daily case load	The number of anesthetic cases performed daily in the respondents' primary practice setting (CRNA respondents).
Support staff availability	Whether the CRNA has support staff upon which to base responses to the subsequent questions (CRNA respondents).
Title of existing ASP	The title used by the ASP to identify them within their department (per ASP supervisors) (CRNA respondents).
FTEs of ASP	The number of ASP employed 40 hours per week (per ASP supervisors).
Qualitative description of position evolution	A brief description of how the department created the ASP positions (per ASP supervisors).
Qualitative description of ASP role per ASP	A brief description of the position from the perspective of the supervisory staff (per ASP supervisors).

Table 1-continued

Variable	Operational Definition
Qualitative description of safety and efficiency added by this role per ASP supervisors	Refers to the ASP supervisors' assessment of the value added to the anesthesia department by the ASP.
ASP chain of command	Position of the ASP within the organizational structure (per ASP supervisors).
CRNAs who work with ASP task list	The tasks currently performed by the ASP with whom the CRNA works (CRNA respondents).
CRNAs who do not work with ASP task list	The tasks CRNAs would like to see performed by ASP assuming ASP were available (CRNA respondents).
ASP education level	Highest education level achieved by the ASP (per ASP supervisors).
ASP anesthesia specific training	Training specific to the current role as ASP (formal vs on-the-job training) (per ASP supervisors).
ASP position requirements	The minimum requirements to obtain an ASP position within a given department.
ASP supervision	The individual to whom the ASP reports (their supervisor).
ASP competence	The extent to which CRNAs believe currently practicing anesthesia technicians are competent to perform the tasks they are assigned. Measured using a scaled score (CAN respondents).
ASP training by technical area (CRNAs with ASP)	Perception of training of current ASP by CRNAs with whom they work (CRNA respondents and per ASP supervisors).
ASP training by technical area (CRNAs with no ASP)	Perception of desired training for ASP by CRNAs with no ASP (CRNA respondents).
Comfort with delegation to c.A.T.	The extent to which CRNAs believe c.A.T.s will follow through on assignments in an effective manner. Measured using a scaled score (CNA respondents).
Perception of patient safety with c.A.T.	The extent to which CRNAs believe c.A.T.s will enhance and ensure the safety of patients. Measured using a scaled score (CNA respondents).

assumption that trauma designation loosely corresponds to size and service offerings. For example, in order to have a higher-level trauma designation, hospitals are required to offer 24-hour coverage of certain high level specialties like neurosurgery, trauma surgery, interventional radiology and an immediately available operating suite. For lower level trauma designations, these services may be available during more limited hours or on an on-call basis.

The number of anesthetizing locations indicates the number of grouped locations where anesthesia is performed (i.e., main operating room, ambulatory surgery suite, dental clinic, endoscopy suite). These locations may have multiple suites grouped together. This number refers to the collective number of different areas indicating the variety of case offerings and implies the geographic distribution of these locations. For example, 25 operating rooms clustered as a group of suites are likely in one general area while 2 operating rooms, 1 endoscopy suite, and 1 cardiac catheterization suite are more likely to be geographically remote. In this example, the number of anesthetizing locations would be one and three, respectively.

The number of anesthetizing suites represents the total number of operating rooms, procedure rooms or other suites where anesthesia is performed. The number of direct anesthesia care providers indicates the number of individuals within the department who directly administer anesthesia. Daily case load is the number of anesthetic cases performed daily in the primary practice setting of the respondent. Case load, number of direct providers, and number of locations indicate the overall size of the department, and are hypothesized to be positively correlated with constructs of competence and perceptions of safety of certified or licensed anesthesia technicians.

Support staff availability indicates whether the CRNA has support staff upon which to base responses to subsequent questions. Responses to the question regarding support staff

availability were used to group CRNAs. Those who had support staff available were to respond to questions about them. Those who do not were to respond to a different set of questions that assume hypothetical availability of ASP.

The title of existing ASP refers to the terms used to identify them within their department and provides descriptive value. The variable, full-time equivalents (FTEs) of ASP, refers to the number of ASP who work 40 hours per week. Measuring FTEs is a way to generate an equivalent number of ASP across different locations because it accounts for part-time and hourly staffing. A brief description of how the department created the ASP position defines the qualitative description of position evolution. The role of anesthesia support staff per the ASP supervisors defines the qualitative description of the position from the perspective of the supervisory staff. Safety and efficiency added by this role refers to the ASP supervisor's assessment of the value added to the anesthesia department by the ASP. These descriptions provided insights into what themes drove the creation of these positions and the evolution to the current role. They aided in describing the underlying context within the work environments that have ASP, which make this role functional.

Chain of command of ASP defines the position of the ASP within the organizational structure. This descriptive information explains how the ASP fit into the overall organization and how the positions are funded. The task list of CRNAs who work with ASP includes the tasks currently performed by the ASP with whom CRNAs work. The task list of CRNAs who do not work with ASP represents the tasks CRNAs would like to have performed by ASP assuming ASP were available. This information serves to describe the work ASP currently perform in greater detail in a more comprehensive way than exists currently in the literature. The contrast of

tasks that CRNAs practicing without ASP would like to have ASP perform provides insight into the appropriateness of this level of delegation.

Education level of ASP is defined as the highest education level achieved by the ASP. Anesthesia specific training is training specific to current role as ASP and distinguishes those who have received formal training for this role (formal versus on-the-job training). Education level and specific training indicate background knowledge and previous experience that are hypothetically positively related to CRNA perceptions of competence, patient safety, knowledge and training. Position requirements refer to the minimum requirements to obtain employment as ASP within a given department. The position requirements indicate the level of training expected by the human resources department in filling these positions. Presumably this is aligned with the job description for these positions.

ASP supervision is defined as the individual to whom the ASP report and indicates the scope of ASP practice. Reporting to someone other than anesthesia suggests that their responsibilities are not limited to just assisting anesthesia. ASP competence is the extent to which CRNAs believe currently practicing anesthesia technicians are competent to perform the task they are assigned. As a variable, ASP competence describes CRNA perceptions of competence of current anesthesia technicians. Hypothetically, competence is positively correlated to ASP education level, comfort with delegation to a certified anesthesia technician (c.A.T), and perception of safety with c.A.T.

ASP training by technical area (CRNAs with ASP) and (CRNAs with no ASP) refers to the perception of training of ASP by CRNAs with whom they work and desired training for ASP by CRNAs with no ASP, respectively. This information serves to describe the CRNA perception of existing ASP training. The contrast of the training that CRNAs practicing without ASP would

like provides insight into the ideal training and education versus the current perception of this training.

Comfort with delegation to c.A.T. reflects the extent to which CRNAs believe c.A.T.s will follow through on assignments in an effective manner. Perception of patient safety with c.A.T. refers to the extent to which CRNAs believe c.A.T.s will enhance and ensure the safety of patients. Comfort with delegation and perception of safety distinguish certification as a possible option to address education and training needs, and assesses CRNA confidence and perception of safety working with anesthesia technicians given the assumption that their ASP were to be certified. CRNA participants were asked to forward the survey to the ASP supervisor with whom they work. CRNAs versus ASP supervisors were directed to the appropriate questions based on previous responses. The ASP supervisors were to answer questions regarding the supervisors' title and role, ASP position requirements, FTEs, training, education, ASP placement within the organizational structure and tasks appropriate for delegation to ASP. In this manner, the perception of the CRNA versus the actual answer of the ASP could be compared on the following variables: education, anesthesia specific training, competence, knowledge, and training. Additionally, the ASP supervisor was asked four qualitative questions to describe the evolution and current role of ASP, perception of safety and efficiency, and perception of the need for ASP certification. The CRNA participant was asked to create a 5-letter code and forward the survey via e-mail to the ASP. The ASP entered that 5-letter code as the first question of the survey to pair the responses.

Pilot Study

Approval for a pilot study to validate the instrument was obtained from the Institutional Review Board (IRB) of Virginia Commonwealth University prior to any data collection. This

approval included waiver of documentation of informed consent. The instrument included an anonymous consent statement on the opening page. The intent of the pilot study was to test the instrument.

Three questions were revised based on poor consistency with what is known demographically about the sample sites. Questions regarding number of in-patient hospital beds, number of annual cases, and number of FTEs (full-time equivalents of ASP) were answered by the respondents but with much wider variation than should represent three practice locations. The open-ended comments about these three questions also included many statements further elucidating inadequate representation. “Don’t Know” or “?” or “Best Guess” appeared repeatedly in the comments box. The questions were revised based on the results of the pilot study to be more specific and more accurately targeted to the sample. The question regarding number of hospital beds was discarded. The number of annual cases was rephrased to daily cases, and FTEs was referred to ASP supervisors rather than practicing CRNAs.

Development of the Initial Scale

Five scales were created by the researcher to measure the constructs relating to training, knowledge, competency, and enhancement of patient safety. The items on these scales were reviewed by a panel of CRNA experts for face validity. Cronbach alpha reliabilities were calculated for the initial predefined scales. The initial constructs with their respective initial Cronbach alpha for each scale are as follows: (a) adequacy of training for ASP specific tasks (alpha = 0.798), (b) adequacy of knowledge of ASP specific tasks (alpha = 0.856), (c) CRNA perception of competency of ASP with whom they currently work (alpha = 0.861), (d) CRNA comfort delegating tasks to c.A.T. (alpha = 0.677), and (e) CRNA perception of c.A.T. patient safety enhancement (alpha = 0.407) after stepwise item reduction (alpha = 0.561).

Procedures

A purposive, convenience sample of CRNAs practicing in one of three practice settings, urban teaching hospital (Virginia Commonwealth University Medical Center [VCUMC]), suburban community hospital, and rural community hospital, was identified from within the states of Virginia and North Carolina. Using these different types of practice settings provided a balanced stratification of clinical settings based on services available at those settings. As such, this purposive sampling provided an opportunity to evaluate a broad range of settings providing response variation. The researcher contacted the chief CRNA in each of those settings by phone and obtained permission to survey the staff. The researcher then forwarded the survey to a professional acquaintance in that practice setting. This contact person forwarded the introduction e-mail and follow-up e-mails to their practice group. In this manner, the researcher did not have access to e-mail addresses that would carry the expectation of privacy. The researcher served as the contact person and directly e-mailed the protocol to the VCUMC staff with whom she works.

The chief CRNA was also asked to briefly describe the ASP utilization in their practice setting during the phone conversation requesting permission to interview participants at their hospital. This description was used to corroborate the data presented from these three groups to further refine the survey items. For example, if the chief CRNA at the suburban community hospital described ASP utilization that is highly limited, but all the survey responses from that size site indicate a higher level of utilization, then those survey items would be refined to make them more specific.

There are 40 CRNAs in practice at VCUMC, 15 CRNAs at the Level II community hospital site, and 6 CRNAs at the Level III rural community hospital site. Of a total sample of 61, 31 (n = 31) individuals completed the survey yielding a response rate of (50.82%). Not all

individuals completed all questions, so the *n* is reported for each individual item in the results. The data were evaluated for possible errors. One response set was discarded because the individual entered the survey, but answered no questions.

Factor Analysis

Factor analysis was used to examine the internal structure of the instrument and revise the theoretical scales to produce the final scale. Evaluation of the principle factors using varimax rotation of the survey instrument revealed 10 factors with eigenvalues of more than 1.0. Using factor loading of 0.50 or higher as the criterion 6 items loaded on factor one, 9 items loaded on factor two, 6 items loaded on factor three, 6 items on factor four, 4 items on factor five, 4 on factor six, 1 on factor seven, 2 on factor eight, and 1 on factor nine. The items and their factor loadings are compiled under each construct heading in Appendix A. The factor loadings were evaluated to determine the underlying construct associated with each. The items and their subscale reliabilities are grouped according to their factor loadings under each construct heading. Items that did not load onto these six subscales were discarded.

Final Scale

The final scale consists of six item subscales. Knowledge of Biomedical Systems (alpha = 0.972) represents the 6 items that loaded onto factor one. This scale includes CRNA ratings of the following:

1. Anesthesia delivery systems (adequacy of ASP training).
2. Anesthesia delivery systems (ASP knowledge).
3. Electrical systems (adequacy of ASP training).
4. Anesthesia monitoring systems (ASP knowledge).

4. Anesthesia monitoring systems (adequacy of ASP training).

5. Electrical systems (ASP knowledge).

CRNA perceived Competency of ASP (alpha = 0.914) represents the 9 items that loaded onto factor two. This scale includes CRNA ratings of the following:

1. Ordering and stocking supplies (adequacy of ASP training).

2. Maintaining anesthesia gas machines (adequacy of ASP training).

3. Maintaining airway equipment (ASP knowledge).

4. Ordering and stocking supplies (ASP knowledge).

5. Communicates effectively with anesthesia staff and the operating room team (ASP with whom you work).

6. Maintaining anesthesia gas machines (ASP knowledge).

7. Is confident in his/her decisions (ASP with whom you work).

8. Is knowledgeable of anesthesia systems and equipment necessary for procedures (ASP with whom you work).

9. Is knowledgeable regarding equipment or supply functions (ASP with whom you work).

Knowledge of Biological Sciences (alpha = 0.955) represents the 6 items that loaded onto factor three. This scale includes CRNA ratings of the following:

1. Physiology (ASP knowledge).

2. IV therapy (ASP knowledge).

3. Physiology (adequacy of ASP training).

4. Pharmacology (ASP knowledge).

5. IV therapy (adequacy of ASP training).

6. Pharmacology (adequacy of ASP training).

ASP General Characteristics (alpha = 0.867) represents the 6 items that loaded onto factor four. This scale includes CRNA ratings of the following:

1. REVERSED – Responds poorly to stress (ASP with whom you work).

2. Functions appropriately in a fast-paced environment (ASP with whom you work).

3. Is technically adept in performing procedures (ASP with whom you work).

4. Is interested in acquiring new skill sets (ASP with whom you work).

5. Reversed - Is NOT attentive to changing demands (ASP with whom you work).

6. Displays an interest in the well-being of the patient (ASP with whom you work).

Patient Safety Enhancement of ASP (alpha = 0.924) represents the 4 items that loaded onto factor five. This scale includes CRNA ratings of the following:

1. Cleaning airway equipment (ASP knowledge).

2. Cleaning airway equipment (adequacy of ASP training).

3. The ability to delegate tasks such as prepare fluids and pressure lines for monitoring, preparing invasive line kits, and preparing equipment for off-site anesthetic procedures to certified anesthesia technicians would enhance patient safety.

4. Maintaining airway equipment (adequacy of ASP training).

CRNA comfort Delegating to c.A.T. (alpha = 0.753) represents the 4 items that loaded on factor six. This scale includes CRNA ratings of the following:

1. I would feel comfortable delegating tasks such as assisting with difficult intubations, assisting with insertion of invasive lines, and initiating intravenous access to certified anesthesia technicians.

2. I would feel comfortable delegating tasks such as lab sample pick-up, ordering supplies, and retrieving equipment to certified anesthesia technicians.

3. The ability to delegate tasks such as assisting with difficult intubations, assisting with insertion of invasive lines, and initiating intravenous access to certified anesthesia technicians would enhance patient safety.

4. I would feel comfortable delegating tasks such as prepare fluids and pressure lines for monitoring, preparing invasive line kits, and preparing equipment for off-site anesthetic procedures to certified anesthesia technicians.

Procedures

The survey questions were loaded into Zoomerang™, an online web-based survey distribution software package. The survey and follow-up e-mails were administered by the AANA, which maintains the database from which the sample is drawn. The AANA does not release e-mail addresses of their membership for survey purposes as a matter of policy. The AANA administered the survey in accordance with the approved request of the researcher, and downloaded the results from Zoomerang™ to Microsoft Excel. The AANA then forwarded the Microsoft Excel database to the researcher.

The survey was administered in accordance with a tailored design procedure modified for the Internet (Dillman, 2007). An e-mail was sent to participants introducing the study and containing a link to the survey. The salience of the survey findings and their participation was emphasized. The e-mail requested that the CRNA forward the e-mail to the ASP supervisor in their primary practice setting with a self-created code in the subject line. Both the ASP supervisor and CRNA entered the survey from the same line contained within the e-mail.

Upon clicking on the link to the survey a web page opened containing an informed consent statement. Participants who consented to participate were directed to the survey. Those who elected not to agree with the consent statement were directed to a nonsurvey "thank you" page. Within the survey, participants were each asked to enter the code they created to link the survey, and they were directed to appropriate questions based on their responses regarding their role in practice.

Follow-up

Approximately 2 weeks later, a follow-up e-mail containing a link to the survey was sent to the participants, which introduced the study, invited them to participate and forward the survey to the ASP supervisor, and thanked them for their participation.

Four weeks following the introductory e-mail, a follow-up e-mail with the survey link attached and forwarding instructions to the ASP supervisors was sent to the AANA sample. The secondary survey completed by the ASP supervisor with whom the CRNA participants work did not have follow-up procedures other than the repeat requests to the CRNA recipient to forward survey. Members of this population were known only to the CRNAs with whom they worked. The primary survey did not solicit their contact information since this carried the expectation of privacy. The survey was availed to the ASP supervisor only through a forwarded link and was therefore untraceable.

Delimitations

The primary delimitation of this study was the use of a surrogate population to assess currently practicing ASP. CRNAs were used to describe ASP because present ASP practice has a limited definition and description making it virtually impossible to identify the sample and gain

access to them. The primary purpose of this study was to present a description of the population, which will aid in resolving this obstacle in future studies.

A secondary delimitation of this study was the restriction of sampling to practicing CRNAs to the exclusion of other anesthesia providers. This sampling pool omitted practicing anesthesiologists and anesthesia assistants. The rationale for this delimitation was that anesthesia assistants presently are only licensed to practice in two states. This practice limitation restricts range of practice settings about which they could provide input. Anesthesiologists were excluded because of the dual roles they serve in mainstream anesthesia practice. They typically either supervise CRNAs or resident trainees, or they provide anesthesia directly themselves. In order to restrict the survey respondents to the role of direct provider who has more direct interaction with assistive personnel only CRNAs were surveyed. Once the survey instrument is further refined, future studies may incorporate additional anesthesia providers in a way that offers a comparison between the perceptions of those in a supervisory role versus a direct patient care role.

CHAPTER 4. RESULTS

This chapter presents the results of the study. The research questions are presented followed by a description of the sample demographics and analysis of the demographics in the context of variability across practice setting and size. The results chapter concludes with the results of data analysis pertinent to each specific research question.

This study was intended to assess the perceptions of practicing certified registered nurse anesthetists (CRNAs) regarding anesthesia support personnel (ASP) and to assess ASP supervisors regarding the education, background and training of ASP. In order to assess perceptions, a survey was administered by the American Association of Nurse Anesthetists (AANA) foundation to 2,500 practicing CRNAs via e-mail. The survey was designed to answer the following research questions:

1. What are the tasks that are delegated to ASP working with CRNAs as reported by CRNAs?

2.What are the educational backgrounds and anesthesia specific training of ASP working with CRNAs as reported by ASP supervisors?

3. To what degree is there a relationship between level of education of ASP reported by supervisor and CRNA level of comfort delegating tasks to ASP, and between ASP level of education (as reported by supervisors) and CRNA perception of competency of ASP with whom they work?

4. What are the ratios of ASP per number of anesthetizing locations and case load? What is the relationship of these ratios to hospital size (as measured by case load, trauma level, annual case load, number of anesthetizing locations and suites)?

5. What is the relationship between practice size and CRNA level of comfort delegating tasks to certified ASP?

Collection

The survey was submitted to the AANA Foundation and loaded into their web-based survey software, Zoomerang™. The AANA Foundation randomly selected 2,500 AANA members who are CRNAs who have provided an e-mail address. The survey was administered according to a Dillman (2007) design modified for web-based survey administration. This included an introductory e-mail inviting survey participation and a follow-up e-mail every 2 weeks for a total of four e-mails to all participants.

Sample

A random sample of $N = 2,500$ was selected from the AANA membership roster by the AANA, which has approximately 40,000 members (American Association of Nurse Anesthetists, 2010). Ninety-eight percent of all practicing CRNAs are members of this organization; as such, this random sample was likely to reflect the population. Of the membership who responded to the 2007 AANA membership survey, 81.1% were employed full time, 14.4% were employed part time, 3.4% were retired, and 1.1% was unemployed (American Association of Nurse Anesthetists, 2008a). The makeup of the group included some representation of most major races including American Indian (0.5%), Asian/Pacific Islander (2.7%), Black/African American (2.4%), and Hispanic (1.7%), although the majority was White/Caucasian (91.7%). The majority of the responding full and part-time employed CRNAs practiced in urban settings (82%) versus

rural settings (18%). The respondents were 56.3% female, and 43.7% male. Median age of the group was 50 years; mean age was 48.4 years.

Sample Demographics

A total of 449 (17.96 %) of the participants accessed the survey. Of that total, 95 (3.8%) elected not to participate in the survey by not agreeing to the opening assent question. The total number of actual respondents was $N = 354$ yielding an actual response rate of 14.16 %. The respondents reported their role, trauma designation, number of anesthetizing locations of their hospital, number of anesthetics conducted daily, and the degree to which anesthesia support personnel were utilized within their department.

The data were exported directly from Zoomerang™ into SPSS Version 16.0 statistical software. The data were reviewed for outliers. Obvious data errors were discarded as described below. When reporting case mix, eight respondents indicated a number of daily cases inconsistent with the physical facilities they reported. For example, one respondent indicated his/her primary practice setting performed 1,500 anesthetics daily in three main operating rooms. Also, several respondents misidentified themselves with regard to whether they had ASP in their environment. As a consequence, during subsequent questions regarding ASP, they reported their area had none. Such cases were not discarded outright, but were added to a category for no ASP. These obvious outliers were not included in data analysis. However, they are reported as they pertain to self-identification issues with the survey. Table 2 presents the number and percent of participants identifying with each role.

The majority were practicing CRNAs (93.8%), while "anesthesia support personnel supervisor and the CRNA who received the original survey request" ($n = 9$) accounted for 2.5% of the respondents. Anesthesia support personnel supervisor ($n = 6$) accounted for 1.7%, and

Table 2

Respondents' Role

Participant's Role	Frequency	%
Anesthesia Support Personnel Supervisor	6	1.7
Anesthesia Support Personnel Supervisor and the CRNA who received the original survey request	9	2.5
CRNA	332	93.8
Other, please specify	7	2.0
Total	354	100.0

"other, please specify" accounted for 2.0% with written comments representing 1 chief CRNA, 1 operating room nurse supervisor, 3 anesthesia technicians or aides, and 2 anesthesia support personnel or technician supervisor. The incongruity between the "other, please specify," respondents' self-selection and subsequent written comments is discussed further in chapter 5. Table 3 presents the trauma designation of the participants' primary practice setting.

Table 3

Trauma Designation of Participants' Primary Practice Setting

	Frequency	%
Missing	19	5.4
Community hospital with no emergency or trauma services	32	9.0
Outpatient setting with no emergency or trauma services	35	9.9
Level III-Resources available to stabilize patient for transport to higher level trauma center.	120	33.9
Level II-Resources immediately available to treat trauma patient in a nonteaching (no surgical residency or research program) hospital.	73	20.6
Level I-Resources immediately available to treat trauma patient.	55	15.5
Other	3	.8
I don't know.	13	3.7
Skip question	4	1.1
	354	100.0

The majority of respondents (~70%) indicated that they worked in a center with a trauma designation, with the majority indicating Level III (33.9%). Level II and I trauma centers represented 20.6% and 15.5% of the respondents, respectively. Fewer than 20% of the

participants indicated that their primary practice setting had no emergency or trauma services. Table 4 presents the title of staff performing tasks related to anesthesia support of the participants' primary practice setting.

Table 4

Number of Staff Performing Tasks Related to Anesthesia Support

	Frequency	%
Missing	15	4.2
Other	6	1.7
No support staff; anesthesia providers share responsibilities	78	22.0
General Operating Room Support staff	86	24.3
*Other-both Operating Room staff and anesthesia support personnel	14	4.0
Support staff dedicated to anesthesia department	155	43.8
Total	354	100.0

* Subset of "other" that included written comments indicating both type of staff are used.

The majority of the respondents (43.8%) reported having "support staff dedicated to the anesthesia department." An almost equal number (46.3%) indicated "no support staff" (22.0%) or "general operating room support staff" (24.3%), both of which are nondedicated support staff. The minority (4.0%) indicated that they used a combination of "both operating room staff and anesthesia support personnel"; however, this number may be artificially diminished because this group was not in the original survey as an option. This 4.0% represents "write-ins" indicating both from the "other" survey option.

Table 5 presents the supervision of staff who perform tasks related to anesthesia support of the participants' primary practice setting. Fifteen percent of respondents with ASP

Table 5

Supervision of Anesthesia Support Personnel

	Frequency	%
Missing	85	24.0
Anesthesiologist	7	2.0
Nurse Anesthetist	43	12.1
Operating Room Nurse Supervisor	65	18.4
An Anesthesia Tech in a supervisory role	66	18.6
Lead or Head Care Partner	4	1.1
Support Staff Supervisor	18	5.1
Housekeeping Supervisor	4	1.1
Orderly Supervisor	2	.6
Very small staff with no direct supervisor-overseen by OR or Anesthesia Staff	54	15.3
Other	6	1.7
Total	354	100.0

indicated that they had a "very small staff with no direct supervisor"; 18.4% and 18.6%, respectively, reported supervision by the "operating room nurse supervisor" and "an anesthesia tech in a supervisory role."

Table 6 presents the title of staff who perform tasks related to anesthesia support in the participants' primary practice setting.

Table 6

Title of Anesthesia Support Staff

	Frequency	%
Anesthesia Technician	183	70.1
Anesthesia Technologist	6	2.3
Care Partner	3	1.1
Nurse's Aide	3	1.1
Operating Room Aide	13	5.0
Operating Room Orderly	5	1.9
Other (nonspecified)	11	4.2
*Anesthesia Aide	8	3.0
*Anesthesia Attendant	2	0.77
*Operating Room Technician	3	1.1
*Patient Care Assistant	1	0.004
*Patient Care Technician	1	0.004
*Registered Nurses or Licensed Practical Nurses	3	1.1
*Multi-skilled Workers	2	0.77
*No Anesthesia Support Staff	17	6.5
Total	261	100.0

*Note: Indicates grouped written-in comments of the participants.

Despite the use of "skip-logic" to guide the participants to appropriate survey questions based on previous responses, 17 (6.5%) of the respondents to this question indicated that their primary practice setting had no support staff in the written comments.

The participants were given the opportunity to participate in a coding process with their anesthesia support personnel supervisor. This was intended to enable the responses of the CRNA receiving the original survey to be compared with the responses of the anesthesia support personnel supervisor. This pairing was introduced into the design due to the inability of CRNAs to answer questions regarding the number, background, and training of anesthesia support personnel when the instrument was initially piloted. Table 7 presents the breakdown of participation in the coding component of the survey.

Table 7

Participation in Coding and Pairing Component of the Survey

	Frequency	%
Entered a code	60	20.3
Chose not to participate in the pairing process	32	10.8
No anesthesia support personnel	114	38.6
No supervisory role for anesthesia support personnel (ASP)	89	30.2
Total	295	100.0

Analysis of ASP Type by Practice Demographic

Although distribution of ASP by practice location was not one of the research questions, it is included as part of the demographic data for the study because it is relevant to the overall description of ASP in the context of their practice. Analysis of ASP type by practice

demographic offers an indication of where ASP are utilized and who has found it beneficial to continuing incorporating them into the anesthesia department. This parallels early pharmacy literature describing the practice types based on size and services offered employing pharmacy technicians (Govern et al., 1991; Hogan, 1985; Stolar, 1988). Furthermore, this level of descriptive detail of a practice community is necessary for evolution to more formal professional organization.

Review of the descriptive statistics of the demographic data reported in the survey revealed that there are differences between who performs anesthesia support staff by type of primary practice setting (trauma designation), mean number of annual cases, and mean number of sites. These relationships were further evaluated statistically to determine their significance. The descriptive statistics across these variables, statistical analysis, and results are presented.

Type of Support Staff by Trauma Level Designation

The descriptive statistics of the survey revealed apparent differences between types of support staff based on practice setting (trauma level designation). This observation raised the question of whether or not a difference exists in type of support staff used based on type of practice setting (trauma level designation). To evaluate this possible relationship, the dependent variable, type of support staff, was evaluated for differences based on trauma level designation, the independent variable, using chi-square analysis. Prior to conducting the analyses all data in which one of the variables was unknown, (i.e., "other," "skip question," or "I don't know" responses) were removed. Additionally, because 14 individuals chose "other" and then wrote in both general operating room staff and support staff dedicated to anesthesia, this "other" group was combined with "support staff dedicated to the anesthesia department" to reduce the number of cells with frequency less than 5 (Daniel, 2005). The frequency count, expected count, and

adjusted residual within each designation are presented by grouping of staff performing anesthesia support tasks by reported trauma designation in Table 8.

There is a significant relationship between who performs support staff functions and type of primary practice setting ($X^2 = 77.382_{(df = 8)}$, $p < 0.001$). Table 8 presents the frequency of staff performing ASP function by type of primary practice setting. Eight of the 15 cells had standardized residuals that contributed significantly to the overall X^2. The significant discrepancies between what is expected and the actual count as indicated by the cell residuals are most prominent in the Level I and II trauma designation and the outpatient settings. These differences reflect a trend toward the Level I trauma setting having a much higher than expected number of "support staff dedicated to the anesthesia department" ($n = 46$) versus an expected count of 27.9 (adjusted residual = 5.4), and a significantly lower number of "no support staff" ($n = 2$) versus an expected count of 12.5 (adjusted residual = -3.7), and "general operating room staff" ($n = 6$) versus an expected count of 13.7 (adjusted residual = -2.6). Level II trauma settings had a higher than expected number of "general operating room support staff" ($n = 27$) versus an expected count of 18.2 (adjusted residual = 2.7), and a lower number of "no support staff" ($n = 5$) versus an expected count of 16.6 (adjusted residual = -3.7). Outpatient settings had a higher number of "no support staff" ($n = 22$) versus an expected count of 7.8 (adjusted residual = 6.1), and a lower number of "support staff dedicated to anesthesia department" ($n = 5$) versus 17.5 (adjusted residual = -4.6). The trend reflects an increase in dedicated anesthesia support staff as acuity of trauma designation increases. The phi coefficient for these relationships = 0.498, which suggests a moderate to strong relationship between the variables of "staff performing anesthesia support tasks" and "trauma center designation".

Table 8

Staff Performing Anesthesia Support Tasks by Trauma Center Designation

	Staff Performing Anesthesia Support Tasks			
Count (Expected Count) Adjusted Residual	General Operating Room Support Staff	No Support Staff; Anesthesia Providers Share Responsibilities	Support Staff Dedicated to Anesthesia Department	Total
Level I-Resources immediately available to treat trauma patient.	6 (13.7) -2.6	2 (12.5) -3.7	46 (27.9) 5.4	54 (54.0)
Level II-Resources immediately available to treat trauma patient in a non-teaching hospital	27 (18.2) 2.7	5 (16.6) -3.7	40 (37.2) .8	72 (72.0)
Level III-Resources available to stabilize patient for transport to higher level trauma center	34 (30.4) 1.0	34 (27.7) 1.7	52 (61.9) -2.3	120 (120.0)
Community hospital with no emergency or trauma services.	5 (8.1) -1.3	9 (7.4) .7	18 (16.5) .6	32 (32.0)
Outpatient setting with no emergency or trauma services	7 (8.6) -.7	22 (7.8) 6.1	5 (17.5) -4.6	34 (34.0)
Total	79 (79.0)	72 (72.0)	161 (161.0)	312 (312.0)

Mean Number of Annual Cases by Type of Support Staff

Owing to the apparent differences in type of support staff based on reported demographic data, the question of whether the mean number of annual cases was different based on type of support staff was posed. The mean, number, and standard deviation by group are presented in Table 9.

Between group differences between the independent variable, four levels of type of support staff, and the dependent variable, mean number of annual cases, were evaluated and reported using a One-way Analysis of Variance (ANOVA). The sample exhibited a skewed distribution of the number of annual cases (skewness = 1.655) and nonhomogenous between group variances (Levene Statistic $_{(df = 3,299)} = 12.236$, $p < 0.001$). Despite these violations of statistical assumptions, ANOVA was used as it is considered robust to minor violations in the assumptions of homogeneity of variance and normal distribution. Additionally, the central limit theorem holds that a large sample size will result in normally distributed sample means even though the sample itself is non-normally distributed (Daniel, 2005). Since the sample size in this case exceeds 100, the central limit theorem supports use of a parametric statistic such as ANOVA despite the non-normally distributed sample.

The mean number of annual cases was significantly different across staff performing anesthesia support tasks ($f_{(df = 3, 299)} = 23.931$, $p < 0.001$). The ANOVA summary table is presented in Table 10.

Table 9

Mean Annual Number of Cases by Type of Staff Performing Anesthesia Support Tasks

Staff Performing Anesthesia Support Tasks	Mean	N	Standard Deviation
No support staff; anesthesia providers share responsibilities.	5643.425	73	5089.307
General operating room support staff.	8652.405	79	7959.800
Other-Both operating room staff and anesthesia support personnel.	18660.000	13	13020.417
Support staff dedicated to anesthesia department.	16146.377	138	11883.276
Other	22750.000	6	17397.672
Total	11983.139	309	10986.724

Table 10

ANOVA Summary Table for Analysis of Mean Number of Annual Cases by Type of Support Staff

Source	SS	df	MS	F
Between groups	6.768	3	2.256	23.931
Within groups	28.19	299	0.094	
Total	34.958	302		

Tukey HSD post-hoc analysis was done using a harmonic mean of sample n's (36.190) since the within group sample sizes were unequal (Coolidge, 2006; Daniel, 2005). Significant differences were identified between "no support staff" (mean = 5643.42 cases) versus "support staff dedicated to anesthesia department" (mean = 16146.38 cases) and versus "other – both operating staff and ASP" (mean = 18660 cases). Significant differences were identified between "general operating room support staff" (mean = 8652.41 cases) versus "support staff dedicated to anesthesia department" (mean 16146.39 cases) and versus "Other – both operating room staff and ASP" (mean = 18660 cases). According to Tukey HSD, all these differences contributed to the overall differences between groups.

Mean Number of Anesthetic Suites by Type of Support Staff

Based on the demographic data reported, the question of whether there were differences in mean number of anesthetic suites based on type of support staff was raised. The mean, number, and standard deviation by staff performing in a support role are presented in Table 11.

Between group differences between the independent variable, four levels of type of support staff, and the dependent variable, mean number of anesthetic suites were evaluated and reported using a One-way Analysis of Variance (ANOVA). The sample exhibited a slightly skewed distribution of the number of annual cases (skewness = 0.988) and nonhomogenous between group variances (Levene Statistic$_{(df = 3,309)}$ = 11.073, $p < 0.001$). Despite these violations, ANOVA was used as it is considered robust to minor violations in the assumptions of homogeneity of variance and normal distribution, and the central limit theorem supports the use of ANOVA despite a non-normal sample distribution since the sample is large (Daniel, 2005). The mean number of suites was significantly different across staff performing anesthesia support tasks ($f_{(df = 3, 309)} = 30.449$, $p < 0.001$). The ANOVA summary table is presented in Table 12.

Table 11

Mean Number of Suites by Type of Staff Performing Anesthesia Support Tasks

Staff Performing Anesthesia Support Tasks	Mean	N	Deviation
No support staff; anesthesia providers share responsibilities.	6.700	70	7.232
General operating room support staff.	13.506	81	11.131
Other-Both operating room staff and anesthesia support personnel.	22.231	13	8.719
Support staff dedicated to anesthesia department.	21.369	149	12.727
Other	15.500	4	10.408
Total	16.082	317	12.591

Table 12

ANOVA Summary Table for Analysis of Mean Number of Anesthetic Suites by Type of Support Staff

Source	SS	df	MS	F
Between groups	11355.543	3	3785.181	30.449
Within groups	38411.953	309	124.311	
Total	49767.495	312		

Tukey HSD post-hoc analysis was done using a harmonic mean of sample n's (36.276) since the within group sample sizes were unequal (Coolidge, 2006; Daniel, 2005). There was a significant difference between "no support staff" (mean = 6.70 suites) and all other groups. Additionally, there was a significant difference between "general operating room staff" (mean = 13.51 suites) and all other groups. These between group differences contributed to the overall differences between groups. "Support staff dedicated to anesthesia department" (mean = 21.37 suites), and "other – both operating staff and ASP" (mean = 22.23 suites) were not significantly different.

Mean Number of Off-site Anesthetizing Suites by Type of Support Staff

Based on the demographic data reported, the question of whether there were differences in mean number of off-site anesthetizing suites based on type of support staff was posed. The mean number of off-site anesthetizing suites for all respondents (N = 279) was 8.285 suites [SD = 8.671]. The mean, number, and standard deviation by staff performing in a support role are presented in Table 13.

Between group differences between the independent variable, four levels of type of support staff, and the dependent variable, mean number of off-site anesthetizing suites were evaluated and reported using a One-way Analysis of Variance (ANOVA). The sample exhibited a substantially skewed distribution of the number of annual cases (skewness = 4.540) with homogenous between group variances (Levene Statistic$_{(df = 3,270)}$ = 0.676, p = 0.567). Despite the violation of the assumption of normal distribution, ANOVA was used as the central limit theorem supports use of ANOVA with this large a sample (Daniel, 2005).

Table 13

Mean Number of Off-sites by Type of Staff Performing Anesthesia Support Tasks

Staff Performing Anesthesia Support Tasks	Mean	N	Deviation
No support staff; anesthesia providers share responsibilities.	5.175	57	6.101
General operating room support staff.	7.000	73	7.427
Other-Both operating room staff and anesthesia support personnel.	11.077	13	7.017
Support staff dedicated to anesthesia department.	9.767	131	9.840
Other	16.400	5	8.295
Total	8.285	279	8.671

The mean number of off-sites was significantly different across staff performing anesthesia support tasks ($f_{(df = 3, 270)} = 4.936$, $p = 0.001$). The ANOVA summary table is presented in Table 14.

Table 14

ANOVA Summary Table for Analysis of Mean Number of Off-sites by Type of Support Staff

Source	SS	df	MS	F
Between groups	1054.800	3	351.600	4.936
Within groups	19234.318	270	71.238	
Total	20289.118	273		

Tukey HSD post-hoc analysis was done using a harmonic mean of sample n's (34.543) since the within group sample sizes were unequal (Coolidge, 2006; Daniel, 2005). A significant difference between "no support staff" (mean = 5.18 off-sites) and "support staff dedicated to anesthesia department" (mean = 9.77 off-sites) accounted for the significance of the difference of mean off-sites across the groups.

Research Question 1

What are the tasks that are delegated to ASP working with CRNAs as reported by CRNAs?

Tasks delegated to ASP working with CRNAs were presented as a series of questions in which 249 participants responded whether or not their ASP completed this task as part of their role. Table 15 depicts the number and percentage of CRNAs who reported delegating the task to their ASP. Tasks that are more often delegated to ASP included nondirect patient care type

Table 15

Tasks Delegated to ASP as Reported by CRNAs With Whom They Work

Task	n	%
Retrieve equipment	232	93.2
Order supplies	213	85.5
Change disposable equipment during operating room turnover	211	84.7
Cleaning and maintenance for specialty anesthesia equipment (fiberoptic bronchoscopes, transesophageal echocardiography probes, ultrasound machines, rapid infusers, fluid warming devices	204	81.9
Prepare pressure lines for patient monitoring	152	60.1
Prepare equipment for anesthetic procedures off-site from the main operating room (such as MRI, ECT, CT scan, intervention radiology, PET scan, etc.)	138	55.4
Prepare fluid lines	127	51.0
Prepare invasive line kits	114	45.8
Laboratory sample pick-up and delivery	107	43.0
Provide support to anesthesia providers in specialty rooms such as neuro, cardiac, thoracic, transplant, and vascular rooms	101	40.6
Assist anesthesia providers during difficult intubations	99	39.8
Assist with the insertion of invasive lines	81	32.5
Perform preoperation check-out of anesthesia machine	73	29.3
Assist with patient transport-stable patients	66	26.5
Assist with patient transport-unstable/ICU patients (assist anesthesia provider)	59	23.7
Initiate IV access	9	3.6

activities such as ordering supplies, cleaning and managing equipment, and replacing disposable equipment between cases. Tasks that involve more preparation of items to be used in patient care were delegated often but less so that nondirect patient care type tasks. These included preparing equipment for off-site locations, preparing fluid lines and monitoring lines, preparing invasive line kits, and providing direct support to anesthesia providers in specialty rooms. Less frequently delegated tasks involved a significant amount of direct patient contact such as assisting with the insertion of invasive lines, performance of the anesthesia machine check-out, and assisting in the transport of patients. Initiating IV access, which constitutes direct patient care, was indicated as being delegated to ASP infrequently.

In addition to the preselected tasks that the CRNAs had the option to select, 35 participants included written comments. These are grouped according to theme and include: restocking the anesthesia work area (n = 6), computer and monitor trouble shooting (n = 2), room runner/gofer type function (n = 1), assisting with anesthetic induction and positioning (n = 1), assisting with peripheral nerve blocks (n = 1) and billing (n = 1). Eight of the participants indicated that they did not have anesthesia support personnel, which is inconsistent with previous responses that they gave, which led them to this question via the skip-logic embedded in the survey.

Research Question 2

What are the educational backgrounds and anesthesia specific training of ASP working with CRNAs as reported by ASP supervisors?

Of the 354 survey responses received, only 15 self-identified as "ASP supervisor" or "ASP supervisor and the CRNA who received the original e-mail." These participants were directed to questions regarding education level and training of support staff. On-the-job training

as an anesthesia technician was indicated as the primary anesthesia related training of the ASP by 14 (100%) of supervisors who responded to this question. Highest education level of ASP was reported by 13 supervisors with 2 (15.4%) reporting "other" and wrote in Ph.D. in Chemical Engineering and certification as an anesthesia technician, 4 (30.8%) reporting a bachelor's degree, 3 (23.1%) reporting some college, 1 (7.7%) reporting some nursing or other health care related degree, and 3 (23.1%) reporting a high school diploma or GED. It is noted that this portion of the survey yielded such a small number of responses that generalizations should be limited.

Research Question 3

To what degree is there a relationship between level of education of ASP reported by supervisor and CRNA level of comfort delegating tasks to ASP, and between ASP level of education (as reported by supervisors) and CRNA perception of competency of ASP with whom they work?

The CRNA participants entered a code and then forwarded the survey to the ASP supervisor with whom they worked in order to pair the responses and evaluate a possible relationship. Of the 354 participants in this survey, only 60 elected to participate in this process and enter a code. Eight of the codes were the same random number string, which likely was part of the survey link, so they could not be paired.

There were only five matching codes, and only one of those survey respondents accurately self-identified as the ASP supervisor directing him/her to the correct arm of the survey. The remaining four self-identified as "other" and indicated a more global administrative role suggesting that ASP supervision was only part of their job. For this reason, the relationships between CRNA level of comfort delegating tasks to ASP and CRNA perception of competency

of ASP with whom they work and ASP level of education could not be evaluated. However, the descriptive statistics for "CRNA level of comfort delegating tasks to ASP" and CRNA perception of competency of ASP with whom they work are presented.

"CRNA level of comfort delegating tasks to ASP" represents a score generated from Likert scale responses (1 = Strongly Disagree to 5 = Strongly Agree) to the following statements:

1. I would feel comfortable delegating tasks such as assisting with difficult intubations, assisting with insertion of invasive lines, and initiating intravenous access to certified anesthesia technicians.

2. I would feel comfortable delegating tasks such as lab sample pick-up, ordering supplies, and retrieving equipment to certified anesthesia technicians.

3. The ability to delegate tasks such as assisting with difficult intubations, assisting with insertion of invasive lines, and initiating intravenous access to certified anesthesia technicians would enhance patient safety.

4. I would feel comfortable delegating tasks such as prepare fluids and pressure lines for monitoring, preparing invasive line kits, and preparing equipment for off-site anesthetic procedures to certified anesthesia technicians.

5. The ability to delegate tasks such as prepare fluids and pressure lines for monitoring, preparing invasive line kits, and preparing equipment for off-site anesthetic procedures to certified anesthesia technicians would enhance patient safety.

The mean score for "CRNA level of comfort delegating tasks to certified ASP" (n = 245) was 19.2 [SD = 4.58] with a range from 5-25 (25 = most comfortable with task delegation). This suggests that CRNAs feel comfortable delegating tasks to certified ASP as on average they indicated "agree" with these statements.

"CRNA perception of competency of ASP with whom they work" represents a construct score generated by adding Likert scale responses (1 = None, 2 = A Little, 3 = Some, 4 = Quite a Lot, 5 = A Great Deal) to the following statements:

1. Ordering and stocking supplies (Adequacy of ASP training).
2. Maintaining anesthesia gas machines (Adequacy of ASP training).
3. Maintaining airway equipment (ASP Knowledge).
4. Ordering and stocking supplies (ASP Knowledge).
5. Communicates effectively with anesthesia staff and the operating room team (ASP with whom CRNAs work).
6. Maintaining anesthesia gas machines (ASP Knowledge).
7. Is confident in his/her decisions (ASP with whom CRNAs work).
8. Is knowledgeable of anesthesia systems and equipment necessary for procedures (ASP with whom CRNAs work).
9. Is knowledgeable regarding equipment or supply functions (ASP with whom CRNAs work).

The mean score for "CRNA perception of competency of ASP with whom they work" ($N = 239$) was 33.2 [SD = 8.34] with a range from 5-45 (45 = perceived most competent). This overall score suggests that CRNAs perceived the ASP with whom they work to be relatively competent since overall they rated the ASP between "Some" and "Quite A Lot" on the scale items.

Research Question 4

What are the ratios of ASP per number of anesthetizing locations and caseload? What is the relationship of these ratios to hospital size (as measured by case load, trauma level, annual case load, number of anesthetizing locations and suites)?

Descriptive statistics for these variables are presented earlier. However, due to the lack of adequate data pairs the ratios of ASP per anesthetizing location and case load and relationship of these to hospital size could not be calculated. The lack of adequate data for pairing will be the subject of further discussion in chapter 5.

Research Question 5

What is the relationship between practice size and "CRNA level of comfort delegating tasks to certified ASP"?

To determine whether a relationship exists between practice size and "CRNA level of comfort delegating tasks to certified ASP," Pearson product moment correlations were calculated. Correlations were evaluated between the independent variables, annual number of cases and number of anesthetizing suites and the dependent variable, "CRNA level of comfort delegating tasks to certified ASP."

The mean number of annual cases for all respondents (n = 309) was 11,983.14 cases [SD = 10986.72]. The mean number of off-site anesthetizing suites for all respondents (N = 279) was 8.2849 suites [SD = 8.671]. The mean score for "CRNA level of comfort delegating tasks to ASP" (n = 245) was 19.2 [SD = 4.58] with a range from 5-25 (25 = most comfortable with task delegation). The annual number of cases and "CRNA level of comfort delegating tasks to certified ASP" demonstrated no statistically significant correlation (r = 0.045; p = 0.256). "CRNA level of comfort delegating tasks to certified ASP" and number of anesthetizing suites demonstrated a statistically significant correlation (r = 0.123; p = 0.034). However, the coefficient of determination (r^2 = 0.015) indicated that even though this relationship is statistically significant, it accounts for a very small amount of variance.

Summary

The data yielded results that corroborate previous studies indicating the variety of settings and configurations of ASP utilization. The titles utilized for this group and the tasks that they perform are consistent with previous findings. The lack of similarity of ASP utilization across practice setting types is an interesting finding not elucidated in previous work. It may lead to improved sampling methods for future studies. The varied backgrounds and training of ASP are consistent with previous findings; however, it is notable that in this first attempt to identify ASP supervisors, the self-selection was poor thus limiting the generalizability of these findings. The implications of the lack ASP supervisory self-identification have significant implications to this and future work and will be discussed subsequently. The CRNAs reported reasonable levels of comfort delegating tasks to ASP and perception of competency of ASP, but these were only minimally to moderately related to practice size suggesting the possibility that some other variable may impact this comfort level. Overall, these findings do not leave sufficient data to definitively answer every research question as intended; however, they do suggest opportunities in which further research may be conducted to more directly assess populations with knowledge of this group. These implications will be discussed more extensively in chapter 5.

CHAPTER 5 – DISCUSSION

Introduction

A survey was administered to practicing Certified Registered Nurse Anesthetists (CRNAs) to determine the utilization of ASP and perceptions regarding ASP in the CRNAs' primary practice settings. Specifically, the study sought to describe the utilization of ASP, assess the perceptions of CRNAs regarding comfort level delegating tasks and ASP competency, and to assess ASP supervisors regarding the education, background, and training of ASP. The survey was administered by the American Association of Nurse Anesthetists (AANA) foundation to 2,500 practicing CRNAs via e-mail. The research questions, descriptive statistics, results and implications for each of the research questions are presented. Subsequent discussion of the overall implications of this investigations and recommendations for future research will be presented.

The study was designed to answer the following research questions:

1. What are the tasks that are delegated to ASP working with CRNAs as reported by CRNAs?

2. What are the educational backgrounds and anesthesia specific training of ASP working with CRNAs as reported by ASP supervisors?

3. To what degree is there a relationship between level of education of ASP reported by supervisor and CRNA level of comfort delegating tasks to ASP, and between ASP level

of education (as reported by supervisors) and CRNA perception of competency of ASP with whom they work?

4. What are the ratios of ASP per number of anesthetizing locations and case load? What is the relationship of these ratios to hospital size (as measured by case load, trauma level, annual case load, number of anesthetizing locations and suites)?

5. What is the relationship between practice size and CRNA level of comfort delegating tasks to certified ASP?

Interpretations

The survey yielded an actual response rate of 14.16% (N = 354). The respondents were from largely community-based hospitals, outpatient centers, or nontrauma centers. Of those, the majority indicated CRNA as their role (n = 332 [93.8%]). Additional respondents included anesthesia support personnel supervisor (n = 6 [1.7%]), anesthesia support personnel supervisor and the CRNA who received the original request (n = 9 [2.5%]), and "other" (n = 7 [2.0%]). The respondents who indicated "other" wrote in as an additional follow-up comment that they were in some way administrative—chief CRNA, nursing supervisor, etc. They further indicated that they were involved in supervising the ASP in their area, however, they did not self-identify as the ASP supervisor. This suggests that these staff may serve in multiple roles and that ASP supervision may be less well defined than previously thought. This combined with the overall response rate led to a lack of adequate numbers for the pairing component of the data analysis.

Of the respondents, 9.0% (n=32) were from CRNAs working at community hospitals, 33.9% (n = 120) were from Level III hospitals, 20.6% (n = 73) represented Level II hospitals, Level I hospitals accounted for 15.5% (n = 55), and outpatient centers comprised 9.9% (n = 35). The majority of respondents reported support staff compositions that were not directly dedicated

to their anesthesia department. While 43.8% (n = 155) reported dedicated ASP, the remainder reported no staff (n = 78 [22.0%]), shared staff between anesthesia and the general operating room (n = 86 [24.3%]), or some combination general and dedicated staff (4.0%, n = 14).

Supervision of anesthesia support personnel yielded even greater variety; the majority of respondents did not answer the question as there were 85 missing responses (24.0%). This is consistent with the n = 78 respondents who indicated "no support staff" to the previous question. "An anesthesia tech in a supervisory role" was indicated as supervisor by 66 respondents (18.6%), "operating room nurse supervisor" by 65 respondents (18.4%), "very small staff with no direct supervisor—overseen by OR or anesthesia staff" by 54 respondents (15.3%), and a "nurse anesthetist" by 43 respondents (12.1%). The few remaining responses included "anesthesiologist" (n = 7 [2.0%]), "housekeeping supervisor" (n = 4 [1.1%]), "lead or head care partner" (n = 4 [1.1%]), "orderly supervisor" (n = 2 [0.6%]), and "other" (n = 6 [1.7%]). These results further support previous findings that the role of ASP is varied and that their supervision is even less well defined across practice settings.

The title used by the support staff as reported by practicing CRNAs was somewhat better defined than their supervisory structure with the majority reporting "anesthesia technician" as the title used in 70.11% (n = 183) cases. The remaining titles were much less frequently utilized: anesthesia technologist (n = 6 [2.3%]), care partner (n = 3 [1.1%]), nurse's aide (n = 3 [1.1%]), operating room aid (n = 13 [5.0%]), operating room orderly (n = 5 [1.9%], and "other" (n = 11 [4.2%]). Despite the use of skip-logic to guide the participants to appropriate survey questions based on previous response, 17 (6.5%) of the respondents to this question indicated that their primary practice setting had no support staff in the written comments.

The coding component of the survey was intended to pair CRNA perception regarding competency and safety of ASP with whom they worked with ASP supervisors' responses regarding training and education. The coding process was utilized because CRNAs who participated in a previous pilot study of the survey instrument were unable to accurately report the training and education of ASP with whom they worked. Sixty participants (16.9%) entered a code, 32 (9.0%) chose not to participate in the pairing process, 114 (32.2%) indicated they had "no anesthesia support personnel," and 89 (25.1%) indicated their department had "no supervisory role for anesthesia support personnel." The survey did not yield an adequate number for the coding process to be useful. However, the overall numbers of CRNAs who work without ASP entirely or work with ASP with no one in a supervisory role are significant (57.3%). This suggests that not only did the coding procedure not work in this survey but also pairing with ASP supervisors in future studies may result in poor yields as well.

The overall descriptions of the staff serving in the ASP role revealed interesting findings based on practice size and type. There was an inordinate concentration of dedicated ASP in some areas, particularly Level I trauma centers and those centers performing a higher number of annual cases 16,000-18,000. A significantly higher number of respondents who reported working at small community hospitals, outpatient centers or nontrauma centers were much more likely to report "no support staff" or "general operating room staff" providing ASP type functions. The mean number of cases conducted annually at hospitals where the CRNAs reported "no support staff" and "general operating room support staff" were 5,643 and 8,652, respectively.

Findings of nonuniform concentrations of ASP are significant for two reasons: (a) they corroborate previous research, and (b) they offer target populations for more focused sampling in future studies. These findings are consistent with previous studies that have surveyed dedicated

support staff utilization in specific practice types such as residency training programs (McMahon & Thompson, 1987). The findings also mirror the descriptions of practice settings described in the conveniently sampled practice survey conducted by the professional organization of ASP (American Society of Anesthesiology Technologists and Technicians). Practice setting types typically have organizations that set standards and serve as resources within that practice community such as the Society for Ambulatory Based Anesthesia (SAMBA). These types of organizations may create sources for sampling to conduct further research regarding the type of ASP utilized within each setting type. Based on the findings presented here, such segmented sampling may be an equally valid method when compared to sampling on a national scale based on provider type.

Research Question 1

What are the tasks that are delegated to ASP working with CRNAs as reported by CRNAs?

The tasks delegated to ASP working with CRNAs, as reported by the CRNAs, are clearly delineated in Table 16. The tasks are presented from most to least frequently reported by CRNAs to be delegated to ASP. The tasks most commonly delegated include those that are less directly associated with patient care. These are technical tasks such as retrieving equipment (n = 232 [93.2%]), ordering supplies (n = 213 [85.5%]), changing disposables (n = 211 [84.7%]), cleaning and maintenance of equipment (n = 204 [81.9%]), preparing pressure (n = 152 [60.1%]) and fluid (n = 127 [51.0%]) lines, preparing equipment for off-sites (n = 138 [55.4%]), and laboratory sample pick-up and delivery (n = 107 [43.0%]). CRNAs reported delegating tasks more closely associated with direct patient care less frequently. These types of tasks included providing support to anesthesia providers in specialty rooms (n = 101 [40.6%]), assisting

anesthesia providers with difficult intubations (n = 99 [39.8%]) or the insertion of invasive lines (n = 81 [32.5%]), performing preoperation check-out of the anesthesia machine (n = 73 [29.3%]), assisting with patient transport of both stable (n = 66 [26.5%]) and unstable patients (n = 59 [23.7%]), and initiating IV access (n = 9 [3.6%]). These trends reflect a self-regulation by a majority of anesthesia departments to limit tasks performed by ASP to those that they may deem less risky or less complicated since the majority of tasks do not involve direct patient care.

These results and trends are similar to those reported in McMahon and Thompson's (1987) survey of chairman of residency training programs in anesthesiology. The respondents to this survey reported that the responsibilities of their ASP varied, but decreased in number as the task became more patient focused. This may reflect on and substantiate the editorial comments by the department chairmen expressing concerns regarding their technician's qualifications. Almost all departments reported that their technicians were responsible for cleaning equipment (97%). Monitor set-up and calibration was a technician responsibility in 80% of departments. Machine maintenance was performed in 67% of departments, while only 35% expected technicians to run blood gases. Almost none of the departments surveyed had technicians who prepare drugs (3%), while 6% reported arterial line insertion as a technician role. Starting intravenous lines was a function of the technician in 14% of the departments.

The ASATT (2008b) survey of its membership revealed a similar type of task distribution. The majority of practicing anesthesia technicians (363 [86.55%]) assisted with some combination of equipment management, workroom management, room turnover, and supply stocking. Specific tasks reported by members of the ASATT, the organization which offers certification for anesthesia technicians, included ordering supplies (361 [85.75%]), assisting with difficult intubations (372 [88.36%]), conducting room turnovers (377 [89.55%]), assisting with

patient transport (262 [62.23%]), assisting with blood warming equipment (386 [91.69%]), and troubleshooting anesthesia machines (388 [92.16%]). The trends toward a slightly higher frequency of performing more direct patient care tasks may be attributed to the sampling of this group including only members of the ASATT. As such, it would be expected that this cohort, which included 176 (41.81%) certified anesthesia technicians, may include a disproportionately higher representation of anesthesia departments that have clearer role and training delineation with concomitant increased expectation of responsibility.

The results of the present study and the McMahon and Thompson (1987) survey mirror early studies of pharmacy technicians. Hogan (1985) observed that while pharmacy technicians were utilized in every state, their practice requirements varied by state, and the tasks they performed were typically nonjudgmental tasks, such as stocking, inventory management, and dispensing under direct supervision. Around the same general time period, a similar evaluation of pharmacy technicians revealed that 102 (56%) of pharmacists felt that pharmacy technicians' functions should be determined by individual department policies and procedures (Govern et al., 1991). In the Govern et al. (1991) study, it was noted that more complicated tasks such as math calculations, reconstitution of drugs, compounding topical preparations, etc. were more likely to be conducted by technicians at larger centers. This coincides with size and may also coincide with a clearer delineation of departmental policies and training.

In both the present study, previous evaluations of ASP, and similar inquiries of pharmacy technicians at analogous evolutionary points of professionalism, the tasks performed tend to vary widely across practice settings. Distinctively, the tasks performed by the groups tend to be self-regulated within a given institution to include those that involve direct patient contact less frequently than those that do not. This may reflect a tendency of those in supervisory roles, both

anesthesia providers and pharmacists, to prefer a clear delineation of training or certification and department policy guidance as a requisite for willingness to delegate more challenging or risky direct patient care tasks. Although the etiology is unclear, this tendency for conservative delegation pervades both professions and may represent a milestone or stage in the development of recognized professions.

Research Question 2

What are the educational backgrounds and anesthesia specific training of ASP working with CRNAs as reported by ASP supervisors?

Using skip-logic, selecting "ASP supervisor" or "ASP supervisor and the CRNA who received the original e-mail" routed respondents to answer questions regarding training and educational backgrounds of ASP. Of the 354 survey responses received, only 15 respondents self-identified as "ASP supervisor" or "ASP supervisor and the CRNA who received the original e-mail." Seven participants (2.0%) selected "other" in response to this question; 1 of these indicated chief CRNA, 1 indicated operating room nursing supervisor, 3 indicated anesthesia technician supervisor, and 4 indicated anesthesia technician in the written response. These write-ins suggest that for some at least, the role of anesthesia support supervision may be in conjunction with other duties, and as a result they may not have identified with this as a singular role. For the coding component of the survey, 89 (30.17%) respondents indicated that even though their department utilized ASP, there was no one serving in a supervisory role for this group. Between the lack of direct ASP supervision and role confusion leading to decreased self-selection, questions directed to ASP supervisors yielded a response rate that is too low to be statistically conclusive.

The responses of these 15 respondents were similar to the findings of previous work. On-the-job training as an anesthesia technician was the primary anesthesia related training of 14 (100%) ASP as reported by the supervisors. Highest education level of ASP was reported by 13 supervisors. Two (15.4%) reported "other" and wrote in Ph.D. in Chemical Engineering and certification as an anesthesia technician, 4 (30.8%) reported a bachelor's degree, 3 (23.1%) reported a high school diploma or GED, 3 (23.1%) reported some college, and 1 (7.7%) reported some nursing or other health care related degree.

Even though the response rate in this study would lead one to lack confidence in the results, the responses indicated in the present study correspond with those identified in previous work. McMahon and Thompson (1987) found that 58% of their (n = 112) sample were high school graduates, 8% were associate degree prepared individuals, 6% were bachelor's degree prepared individuals, and 28% were registered nurses or licensed practical nurses. The vast majority of the respondents (97 [88%]) reported on-the-job training as the main vehicle for training their anesthesia technicians while only nine (8%) had received training in the military and four (4%) had received formal training for this role. The ASATT (2008b) survey of its membership revealed a similar breakdown in educational background. ASATT participants reported their highest level of education to be high school (166 [39.43%]), college-based anesthesia technician program (51 [12.11%]), or completed college (115 [27.32%]). The survey was less specific with regard to educational background and more interested in whether or not the respondents were certified (176 [41.81%]) as anesthesia technicians by the ASATT. There were also specific questions regarding the benefits of certification, which were reported to be increased pay (87 [49.43%]), promotion (43 [24.43%]), requirement to maintain employment

(44 [25%]), and no benefit (61 [34.66%]). These findings of variable educational background and predominant on-the-job training are consistent with the present study and the previous literature regarding ASP. Additionally, these findings mirror the similar evolutionary stage of pharmacy technicians as evidenced in the early pharmacy technician literature.

The presidents of 49 affiliated state chapters of American Society Hospital Phamacists (ASHP) were surveyed in 1985 (Hogan) for the purpose of describing technician use from the perspective of persons familiar with common practices in a given state. Five states had implemented educational requirements. These requirements included high school education in Louisiana, Nevada, and Washington, and were elaborated to include in-service training in Arkansas, and documentation of on the job training in Kansas. Stolar (1988) randomly sampled 875 hospital pharmacists from 5,600 hospitals employing pharmacists with a goal of describing general pharmacy services. Of the 1,336 pharmacy technician FTEs represented by the survey 33.6% were formally trained. When evaluated by size of hospital, pharmacy technicians were formally trained at 23.3% of small hospitals, 32.5% of medium hospitals, and 49.1% of large hospitals. Govern et al. (1991) evaluated 356 hospital pharmacists registered with the Ohio State Board of Pharmacy regarding their perceptions of pharmacy technicians. At the time of the study, Ohio had no pharmacy technician regulation. There was general agreement that the pharmacy technician scope of practice should be more clearly defined, that technician use increases pharmacy efficiency, and that technician training and education should be standardized. These pharmacists believed that the most effective training was an accredited hospital-based training program. Seventy-seven (42.3%) believed pharmacy technicians should be certified, 50 (27.5%) licensed, 32 (17.6%) neither, and 23 (12.6%) were undecided.

These findings of variable education and predominantly on-the-job training are not unique to this study or to the role of ASP. While these findings are not statistically conclusive, they are consistent with previous work in the ASP literature and previous professional evolutionary patterns in the pharmacy technician literature. The lack of accurate self-identification, or even a formally-identified ASP supervisor, creates the need to identify other surrogate informants to describe this population in terms of their education and background.

Research Question 3

To what degree is there a relationship between level of education of ASP reported by supervisor and CRNA level of comfort delegating tasks to ASP, and between ASP level of education (as reported by supervisors) and CRNA perception of competency of ASP with whom they work?

The relationship between CRNA level of comfort delegating tasks to ASP and CRNA perception of competency of ASP with whom they work and ASP level of education could not be evaluated due to the lack of adequate pairing of responses in the sample. Only 60 participants elected to participate in the paring process by entering a code. There were only five matching codes and only one of those survey respondents accurately self-identified as the ASP supervisor.

The descriptive statistics for CRNA level of comfort delegating tasks to certified ASP (mean score = 19.2 with a range from 5-25 [SD = 4.58]) suggests that the CRNAs surveyed are reasonably comfortable (5 = least comfortable and 25 = most comfortable) with delegating of certain tasks to certified ASP. The itemized statements included in this scale centered around comfort level delegating such tasks that were subdivided by question based on varying degree of involvement with patient care. One area assessed comfort delegating tasks such as assisting with

difficult intubations, assisting with insertion of invasive lines, and initiation IV access. Lab sample pick-up, ordering supplies, and retrieving equipment were a second grouping of tasks included in this scale. Preparing fluids and pressure lines, preparing invasive line kits, and preparing equipment for off-site anesthesia procedures constituted a third group of tasks on this scale.

CRNA perception of competency of ASP with whom they work (n = 239) was 33.2 [SD = 8.34] with a range from 5-45 (5 = perceived least competent and 45 = perceived most competent). This scale consisted of items regarding ASP knowledge regarding equipment and supplies, training and knowledge regarding ordering and stocking supplies and maintaining airway equipment and anesthesia gas machines. Additionally, this scale included items regarding ASP ability to communicate effectively and confidence in their decisions.

Previous ASP literature did not attempt to assess CRNA level of comfort with delegating tasks to certified or noncertified ASP. McMahon and Thompson (1987) did note that the chairmen of residency training programs expressed written comments questioning the qualification of the ASP working for their department. These were included as open-ended statements by the chairmen, not as comparable quantitative data. It would seem that the CRNAs responding to the present study are somewhat more comfortable than the respondents to the 1987 study. This may be a function of time and the perception of enhanced qualifications of ASP associated with certification. The ASATT (2008a) did not include any type of subjective evaluation of ASP.

As pharmacy technician professionalism evolved and literature mounted documenting scope of practice and appropriate training modalities, studies were conducted to evaluate this group in terms of competency. In an evaluation of formally-trained technicians (FTT) versus

on-the-job trained (OJTT) pharmacy technicians, cognitive, skill, and overall competency scores were found to be higher for (FTTs) (Thuo & Wertheimer, 1991c, 1992). Training explained most of the variability in cognitive scores. Experience explained most of the variability in skill scores. Training followed by experience was most predictive of overall competency score. Formal training for pharmacy technicians was favored by both groups, although to a greater extent among the FTTs (71.2%) versus 52.1% of (OJTTs). Formal training programs for pharmacy technicians appear to yield the most overall competent pharmacy technicians. Pharmacy technicians trained via both the on-the-job and formal method indicate that formal training is preferable for this role. Furthermore, technicians agreed that certification or licensure by examination is the preferred mode of recognition for competency in this field. A survey of 130 members of the Pharmacy Technician Educators Council (PTEC) revealed that respondents preferred formal vocational/college training to on-the-job training (Moscou, 2000). All agreed that programs should be accredited, but were in disagreement about what agency (50% PTEC/minority ASHP). The majority (94%) believed technicians should have documentation of competency through either licensure or certification (50%), licensure alone (29%), or certification alone (12.5%).

These studies show an interesting link between education and training and perception of competency in the context of pharmacy technicians. It is unfortunate that in the present study, these variables could not be adequately compared. However, it is informative that the use of ASP supervisors as an indirect assessment of training and educational backgrounds of ASP is not a feasible means to obtain this information presently. Previous pilot studies revealed that CRNAs who practice with ASP were unable to provide this information. This new finding indicates that ASP supervisors are not suited to this purpose either. Perhaps, CRNA administrators might be in

a better position to answer these types of questions regarding their staff or perhaps future inquiries should sample CRNAs with a forwarding component directly to the ASP with whom they work. Either of these modalities might provide an opportunity for comparison of CRNA perception of ASP competency and CRNA comfort delegating tasks to certified ASP with education and training of ASP with whom CRNAs work.

Research Question 4

What are the ratios of ASP per number of anesthetizing locations and case load? What is the relationship of these ratios to hospital size (as measured by case load, trauma level, annual case load, number of anesthetizing locations and suites)?

As discussed previously, there were inadequate data pairs to adequately address the questions of the relationship between ASP per number of anesthetizing locations and case load as well as hospital size. This is further discussed within the context of study limitations and implications for future research.

Research Question 5

What is the relationship between practice size and CRNA level of comfort delegating tasks to certified ASP?

The relationship between practice size and CRNA level of comfort delegating tasks to certified ASP was evaluated and found not to be statistically significant based on annual number of cases and number of off-site locations. The relationship between CRNA level of comfort delegating tasks to certified ASP and number of anesthetizing suites was found to be significant, but the relationship accounted for a small amount of variance and as such was not practically relevant.

Previous studies evaluating ASP did not evaluate relationships between size of practice and comfort level with delegation; however, some of the pharmacy literature did look at predominant mechanism of training based on size and job function with respect to general size of the hospital. In evaluating general pharmaceutical services, Stolar (1988) sent self-administered surveys to 875 randomly selected hospitals from the 5,600 short-term hospitals employing pharmacists in the United States. Of the 1,336 pharmacy technician FTEs represented by the survey, 33.6% were formally trained. When evaluated by size of hospital, pharmacy technicians were formally trained at 23.3% of small hospitals, 32.5% of medium hospitals, and 49.1% of large hospitals. Pharmacy technicians in 23.0% of for-profit hospitals versus 34.9% of nonprofit hospitals were formally trained, while 27.2% of multisystem versus 38.4% in independent hospitals were formally trained. Govern et al. (1991) surveyed hospital pharmacists registered with the Ohio State Board of Pharmacy. The mean hospital size was 390.7 beds (ranging from 40-1200 beds), and 90% offered unit dose/admixture services, 83% centralized services, 32% decentralized services. Urban hospitals employed 51.7% of the respondents, while 32.8% worked in suburban and 15.4% in rural settings. Certain functions were more likely to be performed by technicians at larger hospitals. These included math calculations, reconstitution of drugs, compounding topical preparations, packaging and labeling dose unit doses of oral liquids and solids, packaging and labeling unit doses of injectable solutions; filling patient medication bins; preparing intravenous antimicrobials, preparing total parenteral nutrition and auditing controlled substances. Pharmacy technicians at central city hospitals were more likely than suburban or rural technicians to perform math calculations, drug reconstitution, packaging and labeling unit doses of injectable solutions, preparation of large-volume injectable solutions, compounding topical preparations, and maintenance of emergency carts.

While these early works in the field of pharmacy technicians do not directly assess the comfort level of pharmacists in delegating tasks, they do leave the suggestion at least that there was greater autonomy associated with hospital size. This level of autonomy was hypothesized to be associated with increased level of comfort by the supervisory profession in a larger practice setting. This hypothesis was supported by the findings of the current study. However, the minimal correlation suggests little practical meaning. It is likely based on other results of the study, that the field of ASP remains as yet too poorly defined to begin to assess comfort level with delegation.

Limitations of the Study

This investigation was limited by several factors including (a) low response rate, (b) largely quantitative design in the face of a lack of a clear language regarding this group, (c) sampling of surrogate informants, and (d) poor self-identification by these informants.

Response Rate

The study was severely hindered by nonresponse. The response rate of 14.6% included the following breakdown by practice setting: 9.0% (n = 32) were from CRNAs working at community hospitals, 33.9% (n = 120) were from Level III hospitals, 20.6% (n = 73) represented Level II hospitals, Level I hospitals accounted for 15.5% (n = 55), and Outpatient centers comprised 9.9% (n = 35). The web-based format offered a unique opportunity for participants to contact the researcher with questions regarding the study by simply responding to the introductory or follow-up e-mail. Sixty-one participants contacted the researcher in this fashion. Sixteen of these were concerned that they should not participate in the study because they did not have ASP in their primary practice setting. This provided an opportunity for additional explanation and recruitment of CRNAs with no ASP. However, it begs the question of how

many individual CRNA opted not to participate because they saw no relevance to their anesthesia practice. Of the e-mail responses, the remaining 45 CRNAs wanted their names removed from further follow-up. One CRNA reported that she was in education and therefore the survey was not germane to her practice, and one CRNA wanted to know why the study was being conducted and the funding source.

This survey should have been presented as a CRNA practice survey, not a survey specific to practice issues relating to ASP. This would have eliminated the bias toward CRNAs with no ASP feeling that they should not participate in the survey. In reality, CRNAs with no ASP are just as relevant to the study as those with ASP. This was indicated in the introductory and follow-up e-mails, however, based on the e-mails following up about this issue, that was not the CRNAs' perception.

Additional factors that may have influenced the response rate include the fact that even though the survey was mandated to be conducted through the AANA by policy, the introductory and follow-up e-mails were sent as if by the researcher personally. In other words, the AANA administered the survey through their system, but instead of using their logo and e-mail address, they used the researcher's personal e-mail address with no mention of any affiliation with the AANA. In eight of the e-mails asking to be removed from follow-up, the respondents wanted to know how the researcher obtained their information and felt they were being harassed. This was the case despite the fact that the research study was approved and funded by the AANA, the professional organization to which these CRNAs belong which has as its mission to promote research.

Barriers of Surrogate Informants—Sampling, Self-identification, and Language

A third limitation of the study was the reliance on surrogate informants regarding the utilization and practice of ASP. The survey relied on CRNAs and ASP supervisors to provide information regarding ASP practice. This depended on an adequate sample of CRNAs who work with ASP. This population is smaller than the overall sample of CRNAs, since 114 (38.6%) CRNAs indicated that they had "no anesthesia support personnel" in their primary practice setting. The population of potential informants was further reduced because many ASP lack a direct supervisor. Of the CRNAs who responded to the coding question, 89 (30.2%) indicated "no supervisory role for anesthesia support personnel" in their practice setting and did not participate in the coding process. Furthermore, of the ASP supervisors who responded to the survey, seven of them did not accurately self-identify, indicating their primary role as "other" and writing in chief CRNA, operating room supervisor, anesthesia technician, or other relevant administrative role. Even though small in number, this issue with self-identification may suggest a lack of common language regarding the use of ASP that makes assessing these variables via surrogates inaccurate or inappropriate to attempt at this time. Looking at the evolution of pharmacy technicians, the literature did not bear studies yielding competency information regarding this cohort until after several studies had been published describing the population, their role, the tasks they performed, etc. This may have had the effect of priming the surrogate informants with regard to the language describing the pharmacy technicians. They may have been better able to understand and effectively answer subsequent survey questions as a consequence.

Sampling, self-identification, and language limitations are a reflection of the professional infancy of ASP. ASP training is on-the-job thereby tailored to the practice setting and job itself.

This reflects the premise that this professional evolution is based on situated cognition occurring in the individual communities of practice the ASP serve. Reliance on situated cognition as a means to develop this professional group results in a customized ASP practice that is specific to a given setting. This customized practice leads to a non-uniform organizational structure among different practice settings. It is the very nature of this professional evolution that yields the limitations related to sampling, self-identification, and common language, and highlights the need for further ASP role clarity.

Implications for Future Research

Based on this study, there are suggestions for future research related to sampling and identification of research questions. Targeted sampling of populations where the ASP concentration is higher and better identifying surrogate informants may lead to more useful information. Also, waiting to address some of the research questions until a common language regarding ASP exists in the literature and practice community of CRNAs may result in more coherent responses to quantitative questions.

Targeted sampling of high ASP concentration populations could be conducted based on the findings of this study. Since dedicated ASP tended to be present at higher level trauma centers, sampling could be targeted to Level I and II trauma centers to establish more specific practice patterns of ASP. This type of sampling would be more easily focused on the types of education, background, training, and task delegation expected at such centers. Also, it would be more likely to yield surrogates capable of answering questions more effectively based on a greater experience with ASP. Additionally, practitioners in Level I and II trauma centers would be more likely to identify with and value the study since they are more likely to work with ASP possibly yielding a higher response rate.

Coupled with more targeted sampling, identification of surrogates more likely to be familiar with the population of ASP might also help the study. The present investigation presumed that ASP supervisors would be such a group. However, with a large portion of respondents not having a designated supervisor for their ASP and ASP supervisors not accurately self-identifying due to multiple roles, this was not as effective. A more open-ended survey administered to anesthesia administrators allowing them to forward the survey to the most likely source of information in their department might lead to at least a discovery of appropriate surrogates. Subsequent research could be targeted to those surrogates.

Ultimately, the issues of ineffective sampling and use of surrogate informants are compounded by the lack of a common language of understanding regarding ASP within the CRNA practice community. Several CRNAs responded that they had ASP in their primary practice setting, but then later responded that they had no ASP (n = 17 [6.5%]) in responding to questions regarding ASP with whom they worked. This combined with the difficulty of ASP supervisors self-identifying suggests that perhaps there is not yet a common language among CRNAs regarding ASP. The present study identified that the vast majority of ASP function under the title of "anesthesia technician" (n = 183 [70.1%]), followed by "operating room or anesthesia aide" (n = 21 [13.0%]), and "anesthesia technologist" (n = 6 [2.3%]). Knowledge and utilization of the most frequently used titles for the ASP population may be incorporated into future surveys that describe ASP in those terms and then further define the role to achieve better recognition and responses from future survey participants. Instead of using the term ASP, this language might be replaced with "anesthesia tech," or any non-anesthesia provider that supports the role of the direct anesthesia care provider (CRNA or MDA) by performing tasks such as assisting with setups or bringing supplies as needed. As the ASP role is better defined and those

findings are disseminated, a clearer language will evolve in which to base future discussion of ASP practice. This is very similar to what occurred in the early evolution of pharmacy technicians.

Summary

Though the response rate was low and the specific responses to questions of ASP supervisors yielded insufficient data to answer all the research questions, there are some significant and valuable results gleaned from this study. Perhaps the most useful finding is the discovery of ASP practice types that have the highest proportion of dedicated ASP. This will allow future work to be targeted to these areas with the possibility of improving response rate and descriptive detail regarding this profession. Another important observation is that ASP task distribution is predominantly in nondirect patient care tasks at this point in the professional evolution of this group. As tasks become more patient centric, the percent of ASP who engage in them decrease. This suggests that the community of practice of anesthesia providers may be self-regulating based on their own perceived competency of the ASP. Additionally, the recognition that neither CRNAs with whom ASP practice not the ASP supervisors are in a position to answer questions regarding ASP background and education leaves the need to further elucidate a surrogate who can answer those questions. Perhaps in a survey conducted in a practice type likely to have ASP, CRNA responses could be paired directly with ASP responses. Also significant is the lack of a common language framework within which CRNAs can consistently respond to quantitative questions regarding ASP. This acknowledgement of the evolutionary state of the profession, similar to what was analogized regarding early pharmacy technician literature is significant for framing future work. This initial study is uniquely poised to

contribute to the development of such future studies to further describe and add to the professional dialogue regarding ASP.

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Appendix A

Rotated Component Matrix[a] With Factor Loadings and Construct Headings

	Knowledge of Biomedical Systems	CRNA Perceived Competency of ASP	Knowledge of Biological Sciences	ASP Attitudes	Patient Safety Enhancement of c.A.T.s	CRNA Comfort Delegating to c.A.T.s	7	8	9	10
Cronbach Alpha (alpha =)	**0.972**	**0.914**	**0.955**	**0.867**	**0.924**	**0.753**				
Anesthesia delivery systems (adequacy of ASP training).	.912	.254	.198	.134	.015	.057	.085	-.052	-.029	-.039
Anesthesia delivery systems (ASP knowledge).	.912	.184	.221	.174	-.058	-.069	-.063	-.090	.116	.114
Electrical systems (adequacy of ASP training).	.886	-.042	.320	.125	.137	-.034	-.221	-.040	-.129	.000
Anesthesia monitoring systems (ASP knowledge).	.853	.232	.302	.176	-.015	-.112	-.062	-.144	.035	.133
Anesthesia monitoring systems (adequacy of ASP training).	.843	.313	.273	.193	-.083	.078	.085	-.048	.007	-.025
Electrical system (ASP knowledge).	.832	.010	.336	.112	-.142	.174	.043	.037	-.026	-.157
Ordering and stocking supplies (adequacy of ASP training).	.397	.830	-.193	-.070	.171	.146	.023	-.204	.036	.097
Maintaining anesthesia gas machines (adequacy of ASP training).	.232	.826	-.142	.187	-.063	.146	.265	-.030	.008	.271
Maintaining airway equipment (ASP knowledge).	.248	.818	.086	.321	.144	.243	.169	.109	-.025	.101
Ordering and stocking supplies (ASP knowledge).	.465	.729	-.051	.004	.329	.237	-.095	-.076	-.030	-.064
Communicates effectively with anesthesia staff and the operating room team (ASP with whom you work).	-.279	.711	.003	.109	.118	-.230	-.455	.033	-.200	.202

Appendix A -continued

	Knowledge of Biomedical Systems	CRNA Perceived Competency of ASP	Knowledge of Biological Sciences	ASP Attitudes	Patient Safety Enhancement of c.A.T.s	CRNA Comfort Delegating to c.A.T.s	7	8	9	10
Cronbach Alpha (alpha =)	**0.972**	**0.914**	**0.955**	**0.867**	**0.924**	**0.753**				
Maintaining anesthesia gas machines (ASP knowledge).	**.467**	**.710**	**.139**	**.294**	**-.004**	**.166**	**-.013**	**.089**	**.037**	**.082**
Is confident in his/her decisions (ASP with whom you work).	**-.207**	**.675**	**.165**	**.101**	**.222**	**.019**	**-.070**	**-.074**	**-.504**	**-.202**
Is knowledgeable of anesthesia systems and equipment necessary for procedures (ASP with whom you work).	**.220**	**.608**	**-.140**	**.535**	**-.026**	**-.209**	**.044**	**.261**	**-.151**	**-.029**
Is knowledgeable regarding equipment or supply functions (ASP with whom you work).	**.163**	**.571**	**-.077**	**.213**	**.096**	**-.331**	**.013**	**-.532**	**-.116**	**.117**
Physiology (ASP knowledge).	**.343**	**-.109**	**.904**	**.046**	**-.040**	**.039**	**-.021**	**.100**	**-.065**	**-.053**
IV therapy (ASP knowledge).	**.134**	**-.219**	**.872**	**-.122**	**-.067**	**.190**	**-.097**	**.004**	**-.055**	**-.274**
Physiology (adequacy of ASP training).	**.411**	**.164**	**.839**	**.033**	**-.133**	**-.061**	**.201**	**.007**	**-.092**	**-.076**
Pharmacology (ASP knowledge).	**.411**	**.164**	**.839**	**.033**	**-.133**	**-.061**	**.201**	**.007**	**-.092**	**.076**
IV therapy (adequacy of ASP training).	**.081**	**-.249**	**.831**	**-.128**	**-.128**	**.121**	**-.277**	**-.028**	**.226**	**-.153**
Pharmacology (adequacy of ASP training).	**.391**	**.177**	**.812**	**.110**	**-.291**	**-.004**	**.181**	**.039**	**-.084**	**.093**
REVERSED-responds poorly to stress (ASP with whom you work).	**.198**	**.045**	**.019**	**.866**	**.054**	**.032**	**.014**	**-.077**	**-.025**	**.141**

Appendix A -continued

	Knowledge of Biomedical Systems	CRNA Perceived Competency of ASP	Knowledge of Biological Sciences	ASP Attitudes	Patient Safety Enhancement of c.A.T.s	CRNA Comfort Delegating to c.A.T.s	7	8	9	10
Cronbach Alpha (alpha =)	**0.972**	**0.914**	**0.955**	**0.867**	**0.924**	**0.753**				
Functions appropriately in a fast-paced environment (ASP with whom you work).	.129	.239	-.068	.791	-.169	-.325	-.185	-.050	.186	-.138
Is technically adept in performing procedures (ASP with whom you work).	.246	.114	.016	.790	.006	-.011	.043	-.258	.358	.075
Is interested in acquiring new skill sets (ASP with whom you work).	.364	.131	-.082	.745	-.080	.038	.043	-.144	-.170	.015
Reversed-is NOT attentive to changing demands (ASP with whom you work).	-.237	.393	.261	.709	.186	.162	-.049	.020	.067	.291
Displays an interest in the well-being of the patient (ASP with whom you work).	.070	-.005	.083	.562	-.161	.036	-.622	.248	.025	-.073
Cleaning airway equipment (ASP knowledge).	-.041	.106	-.127	-.012	.967	-.019	.088	.079	-.036	-.015
Cleaning airway equipment (adequacy of ASP training).	-.082	.147	-.069	-.063	.956	-.015	.043	.011	-.155	.002
The ability to delegate tasks such as preparing fluids and pressure lines for monitoring, preparing invasive line kits, and preparing equipment for off-site anesthetic procedures to certified anesthesia technicians would enhance patient safety.	.067	-.152	-.349	.120	.790	.155	.068	.130	.324	-.025

Appendix A -continued

	Knowledge of Biomedical Systems	CRNA Perceived Competency of ASP	Knowledge of Biological Sciences	ASP Attitudes	Patient Safety Enhancement of c.A.T.s	CRNA Comfort Delegating to c.A.T.s	7	8	9	10
Cronbach Alpha (alpha =)	**0.972**	**0.914**	**0.955**	**0.867**	**0.924**	**0.753**				
Maintaining airway equipment (adequacy of ASP training).	**.065**	**.523**	**-.104**	**-.121**	**.787**	**-.016**	**.086**	**-.105**	**-.124**	**-.004**
I would feel comfortable delegating tasks such as assisting with difficult intubations, assisting with insertion of invasive lines, and initiating intravenous access to certified anesthesia technicians.	**.119**	**.068**	**.088**	**-.118**	**.055**	**.925**	**.054**	**.152**	**-.160**	**-.007**
I would feel comfortable delegating tasks such as lab sample pick-up, ordering supplies, and retrieving equipment to certified anesthesia technicians.	**.082**	**.527**	**-.208**	**.043**	**-.136**	**.747**	**-.097**	**.030**	**.002**	**-.164**
The ability to delegate tasks such as assisting with difficult intubations, assisting with insertion of invasive lines, and initiating intravenous access to certified anesthesia technicians would enhance patient safety.	**.021**	**-.183**	**.071**	**-.045**	**-.021**	**.732**	**-.056**	**-.153**	**.498**	**.300**
I would feel comfortable delegating tasks such as preparing fluids and pressure lines for monitoring, preparing invasive line kits, and preparing equipment for off-site anesthetic procedures to certified anesthesia technicians.	**-.040**	**.318**	**.164**	**.209**	**.191**	**.677**	**.195**	**.236**	**-.095**	**.331**
My employer would consider increasing funding for anesthesia support services in order to attract certified anesthesia technicians.	**-.095**	**.115**	**.050**	**.183**	**.080**	**.082**	**.933**	**-.124**	**-.037**	**-.017**
REVERSED-having certified anesthesia technicians in my department would have no impact on patient safety.	**-.223**	**-.003**	**.069**	**-.184**	**.100**	**.077**	**-.322**	**.816**	**-.149**	**-.025**

Appendix A -continued

	Knowledge of Biomedical Systems	CRNA Perceived Competency of ASP	Knowledge of Biological Sciences	ASP Attitudes	Patient Safety Enhancement of c.A.T.s	CRNA Comfort Delegating to c.A.T.s	7	8	9	10
Cronbach Alpha (alpha =)	**0.972**	**0.914**	**0.955**	**0.867**	**0.924**	**0.753**				
Having certified anesthesia technicians in my department would enhance patient safety.	**-.100**	**.133**	**.015**	**-.244**	**.092**	**.369**	**.448**	**.617**	**.285**	**-.028**
The ability to delegate tasks such as lab sample pick-up, ordering supplies, and retrieving equipment to certified anesthesia technicians would enhance patient safety.	**.062**	**-.123**	**-.096**	**.155**	**-.042**	**-.060**	**-.169**	**-.011**	**.906**	**-.004**
REVERSED-does NOT use time efficiently (ASP with whom you work).	**.022**	**.307**	**-.209**	**.216**	**-.082**	**.153**	**-.234**	**-.064**	**.077**	**.829**
Having certified anesthesia technicians in my department would enhance patient safety.	**-.100**	**.133**	**.015**	**-.244**	**.092**	**.369**	**.448**	**.617**	**.285**	**-.028**
Reversed-display negative interpersonal skills (ASP with whom you work).	**-.009**	**.039**	**-.139**	**.296**	**-.117**	**.013**	**-.772**	**-.129**	**.282**	**.319**
Laboratory sampling (adequacy of ASP training.	**.408**	**-.298**	**.496**	**.095**	**.177**	**-.343**	**.391**	**.390**	**-.111**	**.059**
Laboratory sampling (ASP knowledge).	**.408**	**-.298**	**.496**	**.095**	**.177**	**-.343**	**.391**	**.390**	**-.111**	**.059**
Having certified anesthesia technicians would be beneficial to my department	**-.295**	**.007**	**.124**	**-.489**	**.444**	**.467**	**.145**	**.058**	**.014**	**-.324**

[a]Rotation converged in 11 iterations

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization

Appendix B

VCU IRB Approval Letter

VCU Memo

Virginia Commonwealth University

Office of Research Subjects Protection
BioTechnology Research Park
BioTech One, 800 E. Leigh Street, #114
P.O. Box 980568
Richmond, Virginia 23298-0568
(804) 828-0868, fax (804) 827-1448

DATE: March 15, 2010

TO: Henry T. Clark, PhD
School of Education
Box 842020

FROM: Lloyd H. Byrd, MS
Chairperson, VCU IRB Panel E
Box 980568

RE: **VCU IRB #: HM12756**
Title: Certified Registered Nurse Anesthetist's (CRNA) Perceptions Regarding Anesthesia Support Personnel (ASP)

On March 9, 2010 the following research study *qualified for exemption* according to 45 CFR 46.101(b) Category 2. This approval includes the following items reviewed by this Panel:

RESEARCH APPLICATION/PROPOSAL: NONE

PROTOCOL: Certified Registered Nurse Anesthetist's (CRNA) Perceptions Regarding Anesthesia Support Personnel, (ASP), received 2/5/10

CONSENT/ASSENT:

- Because the project is exempt from federal regulations, the procedures described in § 46.116 (Consent) and 46.117 (Documentation of Consent) are not applicable to your research study. Nevertheless, the Common Law of the Commonwealth of Virginia, as well as the canons of sound ethics require you to inform potential subjects of foreseeable risks and possible benefits (if any) associated with participation in your research study. Therefore potential subjects should be informed of foreseeable risks and possible benefits of participation in your research study. They should also be informed that they may refuse to participate in your research and they should understand that they might withdraw at any time without penalty.
- This process of informed decision-making should be documented along with other information associated with the study.
- Appendix B, Survey Introduction, version 3-2/1/10, received 2/5/10

ADDITIONAL DOCUMENTS:

- Appendix C, Introductory E-mail, version 3-2/1/10, received 2/5/10
- Appendix D, 2-Week Follow-up E-mail, version 3-2/1/10, received 2/5/10
- Appendix E, 4-Week Follow-up E-mail, version 3-2/1/10, received 2/5/10
- Appendix F, 6-Week Follow-up E-mail, version 3-2/1/10, received 2/5/10

The Primary Reviewer assigned to your research study is Janet Niemeier, PhD. If you have any questions, please contact Dr. Niemeier at jniemeier@vcu.edu and 628-1633; or you may contact Donna Gross, IRB Coordinator, VCU Office of Research Subjects Protection, at dsgross@vcu.edu or 827-2261.

Attachment - Conditions of Approval

Conditions of Approval:

In order to comply with federal regulations, industry standards, and the terms of this approval, the investigator must *(as applicable):*

1. Conduct the research as described in and required by the Protocol.

2. Obtain informed consent from all subjects without coercion or undue influence, and provide the potential subject sufficient opportunity to consider whether or not to participate (unless Waiver of Consent is specifically approved or research is exempt).

3. Document informed consent using only the most recently dated consent form bearing the VCU IRB "APPROVED" stamp (unless Waiver of Consent is specifically approved).

4. Provide non-English speaking patients with a translation of the approved Consent Form in the research participant's first language. The Panel must approve the translated version.

5. Obtain prior approval from VCU IRB before implementing any changes whatsoever in the approved protocol or consent form, unless such changes are necessary to protect the safety of human research participants (e.g., permanent/temporary change of PI, addition of performance/co-laborative sites, request to include newly incarcerated participants or participants that are wards of the state, addition/deletion of participant groups, etc.). Any departure from these approved documents must be reported to the VCU IRB immediately as an Unanticipated Problem (see #7).

6. Monitor all problems (anticipated and unanticipated) associated with risk to research participants or others.

7. Report Unanticipated Problems (UPs), including protocol deviations, following the VCU IRB requirements and timelines detailed in VCU IRB WPP VIII-7).

8. Obtain prior approval from the VCU IRB before use of any advertisement or other material for recruitment of research participants.

9. Promptly report and/or respond to all inquiries by the VCU IRB concerning the conduct of the approved research when so requested.

10. All protocols that administer acute medical treatment to human research participants must have an emergency preparedness plan. Please refer to VCU guidance on http://www.research.vcu.edu/irb/guidance.htm.

11. The VCU IRBs operate under the regulatory authorities as described within:
    a) U.S. Department of Health and Human Services Title 45 CFR 46, Subparts A, B, C, and D (for all research, regardless of source of funding) and related guidance documents.
    b) U.S. Food and Drug Administration Chapter I of Title 21 CFR 50 and 56 (for FDA regulated research only) and related guidance documents.
    c) Commonwealth of Virginia Code of Virginia 32. Chapter 5.1 Human Research (for all research).

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Appendix C

Survey

Anesthesia Support Personnel Survey

Page 1

This survey contains questions regarding anesthesia support personnel. The goal of the survey is to describe the utilization of anesthesia support personnel across the diverse settings where anesthesia is provided. Regardless of whether you work in an environment that has no one dedicated to these tasks or has an entire team devoted to these services, your answers are extremely important. You are the only person who can attest to your perceptions of these services in your practice setting. This information will be useful for determining how providers and supervisors feel regarding the safety and educational needs of support personnel, and as such, have potential to influence policy and practice guidelines.

Your survey responses are completely confidential and cannot be linked to you or your contact information. The survey will require approximately 10-20 minutes to complete. You will have the option to skip any question by not answering it or stop the survey at any time by closing your web browser.

I would like to ask for your permission and participation in this survey.
{Choose one}

( ) I do not wish to participate in this survey. – *go to page 10*
( ) I agree to participate in this survey. – *go to page 2*

Page 2 – (directed here by response 'I agree to participate in this survey' question 1, page 1)

What was the code entered in the forwarded survey you either sent or received?
{Choose one}

( ) [ ]
( ) Not Applicable, my primary practice setting does not have anyone dedicated to anesthesia support.
( ) Not Applicable, I chose not to participate in the forwarding component of the survey request.

What is your role?
{Choose one}

( ) Anesthesia Support Personnel Supervisor (select this if the e-mail was forwarded to you because you are involved with anesthesia support personnel supervision even if you are also a practicing CRNA) – *go to page 9*
( ) CRNA – *go to page 3*
( ) Other – [ ] – *go to page3*

Page 3 - (directed here by response 'CRNA' or 'Other' question 2, page 2)

What is the trauma center designation of your primary practice setting?
{Choose one}

( ) Level I - Resources immediately available to treat trauma patient
( ) Level II - Resources immediately available to treat trauma patient in a non-teaching (no surgical residency or research program) hospital
( ) Level III - Resources available to stabilize patient for transport to higher level trauma center
( ) Community Hospital with no emergency or trauma services
( ) Outpatient setting with no emergency or trauma services
( ) I don't know
( ) Skip question
( ) Other [ ]

How many anesthetizing locations does your department provide anesthesia for? (please indicate number of sites by each area and if there are none, mark "0")
{Rank the following from 1 to 13}

[ ] Main Operating Room Suites
[ ] Ambulatory or Day Surgery Suites
[ ] Obstetrical Suites
[ ] CT scan
[ ] MRI
[ ] ECT suite
[ ] PET scan
[ ] Interventional Radiology
[ ] Cardiac Catheterization Suite
[ ] Lumbar punctures/bone marrow aspirations
[ ] Brachytherapy seed placement
[ ] Radiation therapy
[ ] Endoscopy suite
[ ] Electrophysiology suite
[ ] Other [ ]

Approximately, how many anesthetics does your department perform daily (including ambulatory or day surgery, off-site locations, and obstetrics)?
{Enter text answer}
[ ]

Who performs tasks such as equipment cleaning and routine maintenance, laboratory sample transport, operating room disposables 'turnover', and equipment delivery for your department?
{Choose one}

( ) General Operating Room support staff – *go to page 4*
( ) Support Staff dedicated to anesthesia department – *go to page 4*
( ) No support staff; anesthesia providers share responsibilities – *go to page 8*
( ) Other [ ]

Page 4 – (directed here by response 'General Operating Room support staff' or 'Support Staff dedicated to anesthesia department' question 4, page 3)

This section of the survey deals with questions regarding anesthesia support in your work environment. Please respond considering who assists you during cases by bringing you drugs or equipment, who cleans your equipment, etc.

What is the title of your anesthesia support staff?
{Choose one}

( ) Care Partner
( ) Nurse's Aid
( ) Anesthesia Technician
( ) Anesthesia Technologist
( ) Operating Room Orderly
( ) Operating Room Aid [ ]

What services are currently performed by your anesthesia support staff? (check all that apply)
{Choose all that apply}

( ) Laboratory sample pick-up and delivery
( ) Order supplies
( ) Retrieve equipment
( ) Change disposable equipment during operating room turnover
( ) Cleaning & maintenance for specialty anesthesia equipment (fiberoptic bronchoscopes, Transesophageal echocardiography probes, ultrasound machines, rapid infusers, fluid warming devices, etc.)
( ) Prepare pressure lines for patient monitoring
( ) Prepare fluid lines
( ) Prepare invasive line kits
( ) Assist with the insertion of invasive lines
( ) Prepare equipment for anesthetic procedures off-site from the main operating room (such as MRI, ECT, CT scan, interventional radiology, PET scan, etc.)
( ) Assist anesthesia providers during difficult intubations
( ) Assist with patient transport - stable patients
( ) Assist with patient transport - unstable/ICU patients (assist anesthesia provider)
( ) Perform pre-operation check-out of anesthesia machine
( ) Initiate IV access
( ) Provide support to anesthesia providers in specialty rooms such as neuro, cardiac, thoracic, transplant, and vascular rooms
( ) Other/Comment on the question [ ]

In your opinion, to what extent do the anesthesia support personnel with whom you work display the following attributes . . .

Anesthesia Support Personnel Attributes	None	A Little	Some	Quite A Lot	A Great Deal	Don't Know
Is knowledgeable regarding equipment or supply functions.	o	o	o	o	o	o
Communicates effectively with anesthesia staff and the operating room team.	o	o	o	o	o	o
Is confident in his/her decisions.	o	o	o	o	o	o
Display negative interpersonal skills.	o	o	o	o	o	o
Is knowledgeable of anesthesia systems and equipment necessary for procedures.	o	o	o	o	o	o
Is technically adept in performing procedures.	o	o	o	o	o	o
Is NOT attentive to changing demands.	o	o	o	o	o	o
Is interested in acquiring new skill sets.	o	o	o	o	o	o
Functions appropriately in a fast-paced environment.	o	o	o	o	o	o
Responds poorly to stress.	o	o	o	o	o	o
Displays an interest in the well-being of the patient.	o	o	o	o	o	o
Does NOT use time efficiently.	o	o	o	o	o	o

Page 6

In your opinion, to what extent are the anesthesia support personnel with whom you work adequately trained in the following areas . . .

Anesthesia Support Personnel Training	None	A Little	Some	Quite A Lot	A Great Deal	Don't Know
IV therapy	o	o	o	o	o	o
Anesthesia monitoring systems	o	o	o	o	o	o
Anesthesia delivery systems	o	o	o	o	o	o
Pharmacology	o	o	o	o	o	o
Physiology	o	o	o	o	o	o
Electrical systems	o	o	o	o	o	o
Laboratory sampling	o	o	o	o	o	o
Ordering and stocking supplies	o	o	o	o	o	o
Maintaining anesthesia gas machines	o	o	o	o	o	o
Maintaining airway equipment	o	o	o	o	o	o
Cleaning airway equipment	o	o	o	o	o	o

Certified anesthesia technicians describe those individuals certified by the American Society of Anesthesia Technicians and Technologists. To what extent do you agree with the following statements regarding certified anesthesia technicians assuming they were to be available in your practice setting . . .

Certified Anesthesia Technicians	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't Know
Having certified anesthesia technicians would be beneficial to my department.	○	○	○	○	○	○
My employer would consider increasing funding for anesthesia support services in order to attract certified anesthesia technicians.	○	○	○	○	○	○
I would feel comfortable delegating tasks such as lab sample pick-up, ordering supplies, and retrieving equipment to certified anesthesia technicians.	○	○	○	○	○	○
I would feel comfortable delegating tasks such as prepare fluids and pressure lines for monitoring, preparing invasive line kits, and preparing equipment for off-site anesthetic procedures to certified anesthesia technicians.	○	○	○	○	○	○
I would feel comfortable delegating tasks such as assisting with difficult intubations, assisting with insertion of invasive lines, and initiating intravenous access to certified anesthesia technicians.	○	○	○	○	○	○
Having certified anesthesia technicians in my department would enhance patient safety.	○	○	○	○	○	○
Having certified anesthesia technicians in my department would have no impact on patient safety.	○	○	○	○	○	○
The ability to delegate tasks such as lab sample pick-up, ordering supplies, and retrieving equipment to certified anesthesia technicians would enhance patient safety.	○	○	○	○	○	○
The ability to delegate tasks such as prepare fluids and pressure lines for monitoring, preparing invasive line kits, and preparing equipment for off-site anesthetic procedures to certified anesthesia technicians would enhance patient safety.	○	○	○	○	○	○
The ability to delegate tasks such as assisting with difficult intubations, assisting with insertion of invasive lines, and initiating intravenous access to certified anesthesia technicians would enhance patient safety.	○	○	○	○	○	○
Cleaning airway equipment.	○	○	○	○	○	○

Page 8 – (directed here by response 'No support staff, anesthesia providers share responsibilities' question 4, page 3)

In your opinion, what services should be performed by anesthesia support staff assuming they were to be available in your environment? (Check all that apply)
{Choose all that apply}

( ) Laboratory sample pick-up and delivery
( ) Order supplies
( ) Retrieve equipment
( ) Change disposable equipment during operating room turnover
( ) Cleaning & maintenance for specialty anesthesia equipment (fiberoptic bronchoscopes, Transesophageal echocardiography probes, ultrasound machines, rapid infusers, fluid warming devices, etc.)
( ) Prepare pressure lines for patient monitoring
( ) Prepare fluid lines
( ) Prepare invasive line kits
( ) Assist with the insertion of invasive lines
( ) Prepare equipment for anesthetic procedures off-site from the main operating room (such as MRI, ECT, CT scan, interventional radiology, PET scan, etc.)
( ) Assist anesthesia providers during difficult intubations
( ) Assist with patient transport
( ) Initiate IV access
( ) Perform pre-operation check-out of anesthesia machine
( ) Provide support to anesthesia providers in specialty rooms such as neuro, cardiac, thoracic, transplant, and vascular rooms
( ) Other/comment on the question [ ]

In your opinion, what areas should anesthesia support personnel be trained in? (check all that apply)
{Choose one}

( ) IV therapy
( ) Anesthesia monitoring systems
( ) Anesthesia delivery systems
( ) Pharmacology
( ) Physiology
( ) Electrical systems
( ) Laboratory sampling
( ) Ordering and stocking supplies
( ) Maintaining anesthesia gas machines
( ) Maintaining airway equipment
( ) Cleaning airway equipment
( ) Other/comment on the question [ ]

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Page 9 - (directed here by answer 'Anesthesia Support Personnel Supervisor (select this if the e-mail was forwarded to you because you are involved with anesthesia support personnel supervision even if you are also a practicing CRNA)' question 2, page 2)

Which best describes you?
{Choose one}

( ) staff CRNA
( ) staff anesthesiologist
( ) anesthesia department administrator, CRNA
( ) anesthesia department administrator, anesthesiologist
( ) registered nurse, operating room
( ) operating room administrator
( ) hospital administrator
( ) Other/comment on the question [ ]

How many anesthesia support personnel does your department employ full-time and part-time?
{Rank the following from 1 to 5}

[ ] Full-time
[ ] Part-time (0-10 hours/week)
[ ] Part-time (10-20 hours/week)
[ ] Part-time (20-30 hours/week)
[ ] Other/Comment on the question

What is the highest level of education of your anesthesia support staff (please feel free to ask them or your human resources department if you are unsure)?
{Choose one}

( ) some high school
( ) high school diploma or G.E.D.
( ) some college
( ) some nursing or other health care related training
( ) associates degree
( ) bachelors degree (non health care)
( ) bachelors degree (health care related)
( ) Other/comment on the question [ ]

What specific anesthesia related training have your support personnel received (please feel free to ask them or your human resources department if you are unsure)?
{Choose one}

( ) formal education as an anesthesia technician
( ) on-the-job training as an anesthesia technician
( ) Other/comment on the question [ ]

What are the current minimum position requirements for a job with your anesthesia support services? (check all that apply)
{Choose one}

( ) high school diploma or G.E.D.
( ) associates degree
( ) bachelors degree
( ) certified nurses aide (CNA)
( ) licensed practical nurse (LPN)
( ) emergency medical technician (EMT)
( ) anesthesia technician certification
( ) anesthesia technician certification preferred but not required
( ) previous experience in anesthesia support
( ) previous experience in anesthesia support preferred but not required
( ) Other/comment on the question [ ]

What department are your anesthesia support personnel under in the organizational structure?
{Choose one}
( ) hospital, nursing services budget
( ) hospital, anesthesiology department budget
( ) hospital, support services budget
( ) private practice group, anesthesiologist only
( ) private practice group, CRNA only
( ) private practice group, anesthesiologists & CRNA
( ) I don't know
( ) Other/Comment on the Question [ ]

Briefly describe how and why the positions for your anesthesia support personnel were created?
{Enter answer in paragraph form}
[
]

What is the role of anesthesia support staff in your environment?
{Enter text answer}
[ ]

How important do you believe that role is in terms of efficiency and safety?
{Enter text answer}
[ ]

What are your perceptions of the need for certification of anesthesia support personnel?
{Enter text answer}
[ ]

In your opinion, what services should be performed by anesthesia support staff assuming they were to be available in your environment? (Check all that apply)
{Choose all that apply}

( ) Laboratory sample pick-up and delivery
( ) Order supplies
( ) Retrieve equipment
( ) Change disposable equipment during operating room turnover
( ) Cleaning & maintenance for specialty anesthesia equipment (fiberoptic bronchoscopes, Transesophageal echocardiography probes, ultrasound machines, rapid infusers, fluid warming devices, etc.)
( ) Prepare pressure lines for patient monitoring
( ) Prepare fluid lines
( ) Prepare invasive line kits
( ) Assist with the insertion of invasive lines
( ) Prepare equipment for anesthetic procedures off-site from the main operating room (such as MRI, ECT, CT scan, interventional radiology, PET scan, etc.)
( ) Assist anesthesia providers during difficult intubations
( ) Assist with patient transport
( ) Initiate IV access
( ) Perform pre-operation check-out of anesthesia machine
( ) Provide support to anesthesia providers in specialty rooms such as neuro, cardiac, thoracic, transplant, and vascular rooms
( ) Other/comment on the question [ ]

In your opinion, what areas should anesthesia support personnel be trained in? (check all that apply)
{Choose all that apply}

( ) IV therapy
( ) Anesthesia monitoring systems
( ) Anesthesia delivery systems
( ) Pharmacology
( ) Physiology
( ) Electrical systems
( ) Laboratory sampling
( ) Ordering and stocking supplies
( ) Maintaining anesthesia gas machines
( ) Maintaining airway equipment
( ) Cleaning airway equipment
( ) Other/comment on the question [ ]

Go to page 10

Page 10 – Exit the Survey - (directed here from the end of page 8 and page 9 or response 'I do not agree to participate in this survey' question 1, page 1))

Thank you so much for your time in providing us with this valuable information.

Appendix D

Introductory E-mail Containing Survey Link

Dear Colleague,

I am a CRNA researcher completing my doctoral studies at Virginia Commonwealth University. You are receiving this survey because you are a member of the AANA or were forwarded the survey by a member. This survey contains questions regarding anesthesia support personnel, individuals that provide support to anesthesia providers, but do not directly administer anesthesia themselves. In some hospitals, these individuals are responsible for room 'turnover' between cases, bringing equipment to the room, a 'room runner' function, assisting with certain setups. Their role may range from limited to very extensive, and their training may vary as well. The intent of this survey is to understand who is functioning in this role, the extent of their training, and perceptions about their impact on patient safety.

If you are the original AANA member receiving this survey, please forward the survey to the anesthesia support personnel supervisor (titles may vary) in your primary practice setting. Please include a code that you create (word, phrase or numbers) following the title 'Anesthesia Support Survey –' in the subject line. Remember the code, both you and the person you forward it to will enter it as a survey response. Using this code system and requesting that you forward the e-mail survey link is intended to preserve the privacy of everyone participating in the survey. The survey will launch in a separate browser window that cannot be linked back to either of your e-mail addresses. The code will link the practitioner and supervisor responses, but you both will remain anonymous. Please feel to contact me at mebf@comcast.net if you have any questions, comments, or concerns.

The CRNA practitioner survey will require approximately15 minutes to complete. The supervisor's survey requires approximately 10 minutes to complete. I very much appreciate your help; the extra few steps are designed to preserve privacy while offering a more complete picture of the individuals working in anesthesia support. It is my hope that the knowledge gained through this survey will impact patient safety and anesthesia practice in a positive way.

Click the following link to enter the survey, [LINK TO SURVEY]. Thank you so much for your valuable time and insight,

Mary Bryant Ford, CRNA

Appendix E

Two-week Follow-up E-mail Containing Survey Link

Dear CRNA colleague,

Two weeks ago, I sent you an e-mail with a link to a survey regarding your perceptions of anesthesia support personnel. Because anesthesia practice in the United States is extremely diverse and regardless of your familiarity with dedicated anesthesia support personnel, your answers are of key importance to determining national perceptions regarding this group. This information will help ensure safety and adequate training for this population. Your answers are completely confidential. The survey will take about 15 - 20 minutes to complete.

Please forward the survey to the anesthesia support personnel supervisor (titles may vary) in your primary practice setting. If you don't have anesthesia support personnel, skip this step. Remember to include a code that you create (word, phrase or numbers) following the title 'Anesthesia Support Survey – ' in the subject line. Remember the code, both you and the person you forward it to will enter it as a survey response. This step is intended to preserve the privacy of everyone participating in the survey while preserving the ability to compare different perspectives from the same practice setting.

Thank you so much for your time in helping me to obtain this valuable information. You may complete the survey by clicking [LINK TO SURVEY].

Thank you,

Mary Bryant Ford

Appendix F

Four-week Follow-up E-mail Containing Survey Link

Dear CRNA colleague,

Approximately, two weeks ago, you received a link to an on-line survey inquiring after your views on working with anesthesia support personnel. You are the only person who can attest to your perceptions of the services provided by support personnel in your practice setting. This information will be useful for influencing policy and practice guidelines regarding this group. I recognize your time is extremely valuable, but this survey would benefit greatly from your input. It should only take about 15 - 20 minutes to complete.

Please forward the survey to the anesthesia support personnel supervisor (titles may vary) in your primary practice setting. If you don't have anesthesia support personnel, skip this step. Remember to include a code that you create (word, phrase or numbers) following the title 'Anesthesia Support Survey –' in the subject line. Remember the code, both you and the person you forward it to will enter it as a survey response. This step is intended to preserve the privacy of everyone participating in the survey while preserving the ability to compare different perspectives from the same practice setting.

If you have any questions, please feel free to contact me at mebf@comcast.net. Again, thank you in advance for your time and willingness to share your unique practice experience. You may complete the survey by clicking [LINK TO SURVEY].

Thank you,

Mary Bryant Ford

Vita

Mary Bryant Ford was born on May 30, 1977 in Mt. Airy, North Carolina and is a citizen of the United States of America. She was raised on a farm in Claudville, which is located in Patrick County in the southwestern region of the state of Virginia. She lived there with her parents, George and Faye Bryant, and one sister, Sandra. She attended Patrick County High School and graduated as salutatorian in 1995. She attended Radford University earning a Bachelor of Science in Nursing and a Bachelor of Arts in Foreign Languages with a concentration in Spanish in 1999.

From July of 1999 until she returned to graduate school in August of 2001, she worked as a staff nurse in physical medicine and rehabilitation and the Neuroscience Intensive Care Unit of the VCUMC. She earned a Master of Science in Nurse Anesthesia from VCU in December, 2003. She has practiced as a staff nurse anesthetist since February 2004. On July 1, 2006, she expanded that role to include clinical supervision of the anesthesia support personnel of the Department of Anesthesiology at the VCUMC. Her doctoral studies were in the Ph. D. in Education - Urban Services Leadership track at Virginia Commonwealth University.