

# A NATIONAL SURVEY OF CERTIFIED REGISTERED NURSE ANESTHETISTS' KNOWLEDGE, BELIEFS, AND ASSESSMENT OF HERBAL SUPPLEMENTS IN THE ANESTHESIA SETTING

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*This study explored Certified Registered Nurse Anesthetists' (CRNAs') knowledge about 8 common herbal supplements that potentially cause perioperative complications, beliefs regarding herbal supplement–anesthesia interactions, and preoperative assessment practices.*

*A multiple-choice descriptive survey was mailed to a random sample of CRNAs from the American Association of Nurse Anesthetists (AANA). Although response was low (19%, N = 191), respondent demographics corresponded to AANA 2002 CRNA membership. The mean knowledge score of adverse interactions was 21%; 17% of CRNAs indicated confidence in their familiarity with herbal supplement–anesthesia interactions. Of the participants, 23% correctly identified the ASA recommendation to discontinue herbal supplements 2 weeks before surgery. CRNAs agreed*

*that herbal supplement use should be assessed preoperatively (92%), they are medically active (88%), and they can have an impact on surgical outcomes (87%). Nearly 4 in 10 respondents used herbal supplements themselves, but only 5% recommend supplement use to patients. Most CRNAs (93%) wanted more educational opportunities on anesthesia and herbal supplements.*

*The low knowledge scores and lack of confidence in familiarity with herbal supplement–anesthesia interactions highlight the need for further CRNA education. Nurse anesthesia educational curricula and continuing education programs should be reviewed and updated to ensure adequate instruction on herbal supplements.*

**Key words:** Anesthesia, herbal assessment, herbal supplements, nurse anesthesia.

**D**uring the past 2 decades, there has been a significant increase in the use of dietary supplements and natural remedies, which include herbal medications, vitamins, and medicinal foods.<sup>1</sup> American adults spend an estimated \$3.5 billion on herbal products annually.<sup>2</sup> One study found that the majority of natural remedy users are turning to alternative medicines because they find them to be more congruent with their own values, beliefs, and philosophical orientations.<sup>3</sup> Many of these natural remedies are not prescribed by healthcare providers and are available over the counter without a prescription or medical direction.

In 1995, a national study found that 29,000 different preparations of herbal supplements and nutraceuticals were available to the consumer over the counter.<sup>4</sup> Many people who use natural remedies do not believe they are medications but just safe, natural supplements to a healthy dietary plan. However, recent medical studies contradict these perceptions of harmlessness in natural remedies. Some herbal supplements are beginning to be linked to potentially adverse alterations in cardiovascular, neuromuscular,

and metabolism functions, as well as to alterations in blood clotting.<sup>5</sup> These alterations can be exaggerated if herbal supplements are used concurrently with prescription medications. Anesthesia providers must be aware of these possible interactions to reduce intraoperative anesthetic and surgical risks.

In 1994, the Dietary Supplement Health Education Act exempted dietary supplements, including herbal preparations and vitamins, from US Food and Drug Administration (FDA) oversight.<sup>6</sup> This exemption allowed dietary supplements to be offered publicly without premarketing approval or submission of safety and efficacy data to the FDA. With the lack of FDA regulation and standards, the herbal supplement market has been freed of the need to standardize or analyze products for potency.<sup>4</sup>

Research demonstrates the lack of standardization in dietary supplements. One study examined 25 different preparations of ginseng for potency, and found that 5 samples had more than the stated concentration of ginseng and 6 had less than the label claimed.<sup>5</sup> Concentrations ranged from 10.8% to 327.7% of the label's claim of active ingredient per caplet. Other

research examined 10 different preparations of St John's wort and found potency ranged from 20% to 135%, with 3 of the 10 products having less than 50% of the stated potency.<sup>7</sup> Reasons for variability in potency of herbal supplements may be due only partially to nonstandard processing and manufacturing methods.<sup>8</sup> Environmental conditions, including soil type, temperature, moisture, length of cultivation, and harvest times, also may affect active ingredient concentrations.

Lack of regulation also exempts the manufacturer from ensuring that the product is free of contaminants. One study examined 260 Asian patent medicines for undeclared pharmaceuticals and heavy-metal contaminants.<sup>9</sup> Asian patent medicines consist of multiple products, including herbs, plants, minerals, and animal parts, formulated into pills or liquids for ease of consumption. Of the 260 products, 17 contained drugs that were not identified on the label and 95 products contained lead, mercury, or arsenic. The levels of the contaminants found ranged from 10 to 319 parts per million (ppm) for lead, 22 to 5,070 ppm for mercury, and 20 to 114,000 ppm for arsenic. To understand the alarming significance of these contaminant levels, the US Pharmacopoeia limits heavy metal contamination in oral medications to 30 ppm, with lower limits for lead, mercury, and arsenic.

From 1990 to 1997, the use of herbal remedies increased 380% in the United States, and more than 15 million adults reported combining herbal supplements with prescription medications.<sup>10</sup> In 2000, a study of 500 surgical patients found that 51% of the patients took herbs during the 2 weeks before a surgical procedure, including 27% who consumed herbs that may inhibit blood coagulation, 12% herbs that affect blood pressure, 9% herbs that increase sedation, 5% herbs that had effects on heart rate and electrical rhythm stability, and 4% herbs that affect electrolyte levels.<sup>11</sup> As many as 70% of patients using herbal supplements do not disclose the use of the supplement during a routine anesthetic preoperative evaluation because they believe that the supplement is not a medication.<sup>1,6</sup>

The physiological alterations caused by herbal supplements can be magnified in the surgical setting, increasing the risk of morbidity and mortality.<sup>12</sup> In 1997, reports in medical literature implicated herbal medication use in more than 100 deaths nationally.<sup>13</sup> One study identified 8 herbal supplements that pose the greatest potential risks in surgical patients: Echinacea, Ephedra, garlic, ginseng, Ginkgo biloba, kava kava, St John's wort, and valerian root accounted for more than 50% of all single herb preparations sold in

the United States in 2000.<sup>14</sup> Given the emerging evidence regarding herbal supplement effects on surgical outcomes, the American Society of Anesthesiologists (ASA) has recommended discontinuation of all herbal use 2 weeks before any surgical operation.<sup>15</sup>

To date, only 1 published study has evaluated healthcare providers' knowledge of herbal supplement interactions and assessment of herbal supplement use in their patient populations.<sup>16</sup> The study randomly surveyed 193 medical providers at 5 different levels of education: medical students, interns, residents, fellows, and attending physicians. The authors found the majority of participants said they ask about alternative remedies sometimes, but most providers never check the side effects and interactions of these remedies in a reference text.

The purpose of this study was to evaluate the knowledge, beliefs, and assessment practices of Certified Registered Nurse Anesthetists (CRNAs). The following research questions guided the study: (1) What are CRNA practices regarding herbal supplement assessment in the perioperative setting? (2) What are CRNA beliefs about the medical efficacy of herbal supplements, need for preoperative evaluation, and effects of herbal supplements on surgery? (3) What is the CRNA knowledge level regarding the 8 most common herbal supplements that have a potential for perioperative complications in the surgical setting? and (4) Is there any relationship between knowledge scores and gender, age, years of practice, location of practice, or personal use of herbal supplements?

## Methods

This study was a random survey of practicing CRNAs from the American Association of Nurse Anesthetists (AANA). The criteria for selection included certified and recertified CRNAs who were members of AANA in 2002. Approximately 25,000 CRNA members of AANA met the study criteria. With approval of the AANA, a random sample of 1,000 eligible members was drawn and sent the study instrument.

• *Data collection instrument and procedures.* A multiple-choice questionnaire was developed for this study because no appropriate existing instrument could be located. The survey was developed in consultation with 2 doctorally prepared nurse faculty, a CRNA educator, and a nurse researcher. They evaluated the survey for content validity, readability, and internal consistency. The survey consisted of 53 items, including demographics, individual attitudes and perceptions of herbal supplement use, assessment practices, sources of herbal education, and questions related to knowledge of the potential adverse effects of the 8 herbal

**Figure 1. Questionnaire on herbal supplement knowledge and beliefs**

1. How many years have you been a practicing CRNA?                      1-3            4-6            7-10            11-15            15-20            >20

2. Please circle *each* level of education you have completed.

Nursing diploma DNSc	Bachelor's degree in nursing PhD	Master's degree in nursing Anesthesia Certificate PhD	Doctorate degree in nursing ND Bachelor's degree-other List: _____
Master's degree-other List: _____	Doctorate degree other EdD		

3. What is your gender?    Male    Female

4. Please circle your age category.                      20-29    30-39    40-49    50-59    60-69    69+

5. In what state do you practice most?            Please write in the state: \_\_\_\_\_

6. Please circle the practice setting in which you practice most.

For-profit hospital	Nonprofit hospital	Academic/teaching hospital	Surgery center	Military
Office-based	Private practice	Agency/traveling/locum tenens	Other: _____	

7. Please mark the best description of your regular practice setting.

CRNA only            CRNA and anesthesiologist            CRNA-students of anesthesia-anesthesiologist

8. Which best describes your anesthesia practice setting?    Urban    Suburban    Rural    Military    Other: \_\_\_\_\_

9. Approximately how many anesthetic procedures are performed at your workplace each day?  
Please write in the number: \_\_\_\_\_

10. Who is usually responsible for obtaining preoperative evaluations at your primary workplace?  
Self            Preop nurses            Physician            Anesthesiologist            Another CRNA            Other: \_\_\_\_\_

11. Are evaluations performed by others reviewed verbally with the patients prior to anesthesia?  
Yes            Sometimes            No

12. Does your preoperative evaluation form have a listed assessment of herbal supplement use?  
Yes            No

13. How do you learn about herbal supplements? (circle all that apply):  
Friends or family    Coworkers    Continuing education    Media    Family physician    Other: \_\_\_\_\_

14. I feel confident in my knowledge base of herbal supplements and anesthesia.  
Strongly disagree            Disagree            Neutral            Agree            Strongly agree

15. I would like more educational opportunities regarding herbal supplements and anesthesia.  
Strongly disagree            Disagree            Neutral            Agree            Strongly agree

16. The American Society of Anesthesiologists' (ASA) position on herbal supplement use and anesthesia:  
Stop 1 week before surgery    Stop 2 weeks before surgery    Stop 1 month before surgery    I don't know  
No need to stop herbal use    The ASA does not have a recommendation for herbal use and anesthesia

17. Herbal supplements are not medically active medications.  
Strongly disagree            Disagree            Neutral            Agree            Strongly agree

18. Herbal supplement use can have an impact on surgical outcomes.  
Strongly disagree            Disagree            Neutral            Agree            Strongly agree

19. Herbal supplement use can enhance health for patients who use them.  
Strongly disagree            Disagree            Neutral            Agree            Strongly agree

20. Herbal supplements do not need to be evaluated on preoperative assessments.  
Strongly disagree            Disagree            Neutral            Agree            Strongly agree

**Figure 1. Questionnaire on herbal supplement knowledge and beliefs (continued)**

<b>21. Herbal supplements do not have any impact on surgical outcomes.</b>						
Strongly disagree	Disagree	Neutral	Agree	Strongly agree		
<b>22. Herbal supplements should be considered medically active medications.</b>						
Strongly disagree	Disagree	Neutral	Agree	Strongly agree		
<b>23. Herbal supplement use should be evaluated on every preoperative assessment.</b>						
Strongly disagree	Disagree	Neutral	Agree	Strongly agree		
<b>24. Herbal supplements do not enhance health for patients who use them.</b>						
Strongly disagree	Disagree	Neutral	Agree	Strongly agree		
<b>25. I personally use one or more herbal supplements.</b>			Regularly	Occasionally	Rarely	Never
<b>26. I recommend herbal supplement use to family and friends.</b>			Regularly	Occasionally	Rarely	Never
<b>27. I discourage herbal supplement use to family and friends.</b>			Regularly	Occasionally	Rarely	Never
<b>28. I recommend herbal supplement use to patients.</b>			Regularly	Occasionally	Rarely	Never
<b>29. I discourage herbal supplement use to patients.</b>			Regularly	Occasionally	Rarely	Never

**Please choose the correct answer that corresponds to the following statement:**

I am familiar with the side effects, common medicinal uses and possible anesthesia implications of the following herbal supplements.

<b>30. Ephedra</b>	Strongly agree	Agree	Neutral	Disagree strongly	Disagree
<b>31. Ginseng</b>	Strongly agree	Agree	Neutral	Disagree strongly	Disagree
<b>32. Ginkgo biloba</b>	Strongly agree	Agree	Neutral	Disagree strongly	Disagree
<b>33. Valerian root</b>	Strongly agree	Agree	Neutral	Disagree strongly	Disagree
<b>34. Kava kava</b>	Strongly agree	Agree	Neutral	Disagree strongly	Disagree
<b>35. Garlic</b>	Strongly agree	Agree	Neutral	Disagree strongly	Disagree
<b>36. Echinacea</b>	Strongly agree	Agree	Neutral	Disagree strongly	Disagree
<b>37. St John's wort</b>	Strongly agree	Agree	Neutral	Disagree strongly	Disagree

**Please choose the correct herbal supplement that corresponds to each statement:**

**38. May cause hepatotoxicity and interfere with immunosuppression (ie, organ transplants).**

Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					

**39. May cause irreversible inhibition of platelet aggregation and possibly decrease cholesterol levels.**

Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					

**40. May cause hypoglycemia with preoperative fasting and inhibition of coagulation cascade.**

Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					

**41. May cause GABA mediated hypnotic effects and reversible scaly cutaneous eruptions with long-term use.**

Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					

**42. May inhibit serotonin, norepinephrine and dopamine reuptake by neurons.**

Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					

**43. May precipitate a benzodiazepine-like withdrawal syndrome if suddenly discontinued after long-term use.**

Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					

**Figure 1. Questionnaire on herbal supplement knowledge and beliefs (continued)**

<b>44. May increase sympathetic stimulation, heart rate, blood pressure and dysrhythmias with anesthesia.</b>						
Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					
<b>45. May be associated with poor wound healing, opportunistic infections, and allergic reactions.</b>						
Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					
<b>46. May alter vasoregulation, modulate neurotransmitter/receptor activity, inhibit platelet-activating factor.</b>						
Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					
<b>47. May lower blood pressure—found to decrease systemic and pulmonary vascular resistance in animal tests.</b>						
Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					
<b>48. May have action similar to steroid hormones; prolong thrombin and activated partial thromboplastin time.</b>						
Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					
<b>49. May increase cytochrome P-450 metabolic activity and may affect digoxin pharmacokinetics.</b>						
Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					
<b>50. May produce dose dependent sedation and hypnosis; tapered dosing needed to inhibit withdrawal.</b>						
Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					
<b>51. May have antioxidant properties, inhibit platelet activating factors, and used in cognitive disorders.</b>						
Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					
<b>52. May have anti-epileptic, neuroprotective and local anesthetic effects in the central nervous system.</b>						
Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					
<b>53. Chronic use may result in tachyphylaxis/hemodynamic instability from endogenous catecholamine loss.</b>						
Echinacea	Ephedra	Garlic	Ginkgo biloba	Ginseng	Kava kava	St John's wort
Valerian root	I don't know					

supplements commonly encountered in anesthesia practice (Figure 1). Before initiation of the study, approval was obtained from the institutional review boards of the University of Minnesota, Minneapolis, and Minneapolis Veterans Affairs Medical Center.

The surveys were mailed to 1,000 potential respondents. Of the 192 surveys returned, 1 survey was blank, creating a sample of 191 surveys, which is a response rate of 19.1%. Although the response rate of the survey was low, the demographic data collected were similar to the AANA demographic data for the 2002 CRNA membership<sup>17</sup> (Table 1). The survey participants were slightly younger than the 2002 general membership but were proportionally similar based on age brackets in decades. The percentages of respon-

dents from each gender matched the AANA membership—respondents were 45% men and 55% women. A slightly higher percentage of survey respondents practiced in academic settings with anesthesiologists and students of anesthesia, as opposed to CRNA-only or CRNA-anesthesiologist teams. This difference may be attributed to a tendency of practitioners in an academic setting to be more likely to participate in research than CRNAs who are in other settings.

The greatest proportion of respondents was in the 40- to 49-year-old category (40%), which corresponds to the 2002 AANA median age category for practicing CRNAs. Approximately 44% of the CRNAs surveyed said they had been practicing for more than 15 years, and 28% had been practicing for 1 to 6 years or 7 to

**Table 1. Comparison of survey sample (n = 191) and AANA 2002 membership demographics**

Demographic	Survey sample (%)	AANA 2002 membership (%)
<b>Gender</b>		
M	45	45
F	55	55
<b>Age (y)</b>		
Younger than 30	5	2
30-39	23	19
40-49	40	42
50-59	26	31
60+	6	6
<b>Location of practice</b>		
Hospital	66	85
Academic	16	6
Surgery center	6	7
Office and other	12	2
<b>Type of practice</b>		
CRNA	21	27
CRNA + anesthesiologist	51	68
CRNA + student + anesthesiologist	28	5
<b>Geographic location</b>		
Urban/suburban	76	84
Rural	24	16

15 years. Respondents primarily practiced in a hospital setting (66%), with 31% in an academic setting (16%), and the remainder in a surgical center (11%) or in other settings (12%). The total is greater than 100% because some respondents reported more than one practice setting. The majority of CRNAs surveyed were from urban settings (45%) as opposed to suburban (31%) or rural practice (24%).

• *Data analysis.* Frequencies and percentages were calculated for survey responses. The 8 questions regarding the anesthetists' personal beliefs about the medical efficacy, need for preoperative evaluation, and surgical impact of herbal supplements were reverse scored for negatively stated questions and combined. Then a correlation matrix and a Cronbach  $\alpha$  were used to analyze the internal consistency and scale reliability. The 8 items formed a single scale with good internal consistency (Cronbach  $\alpha$ , .82).

Personal herbal supplement use was stratified into regular or occasional users and rarely or never used nonusers within the survey. Responses were examined after being dichotomized into groups of users (regular and occasional use) and nonusers (rarely use and never use). The knowledge of herbal interactions score was calculated as the percentage of correct

answers of a total possible score of 16. Knowledge scores were recalculated omitting the Ephedra items because Ephedra is an herb with properties and effects identical to those of ephedrine, which is used regularly in the anesthesia setting. The proportion of "I don't know" responses in the knowledge section also was analyzed. To compare mean knowledge scores by gender, geographic location, and between users and nonusers, *t* tests for independent samples were performed. Pearson product-moment correlations were performed to compare the mean knowledge scores by age and years practicing as a CRNA. Differences in mean knowledge scores by type of clinical setting were tested (after grouping responses into hospital setting, academic setting, and other) using analysis of variance. Analysis of variance also was used to compare mean knowledge scores among urban, suburban, and rural practice settings.

## Results

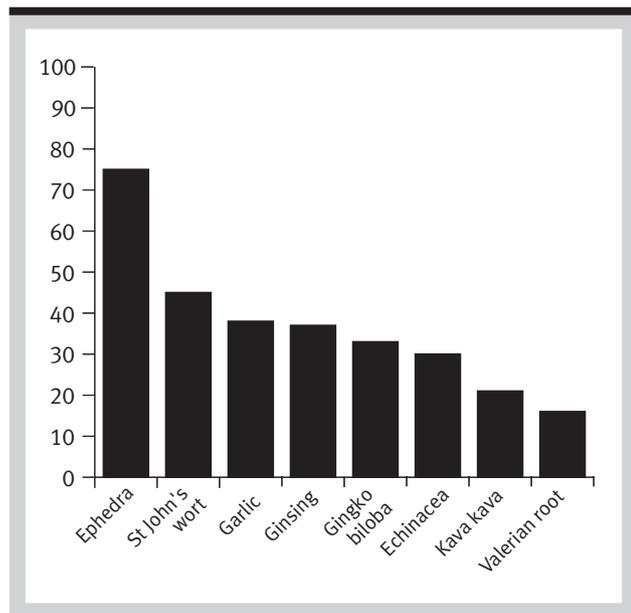
• *Preoperative assessment.* The overwhelming majority (80%) of the 191 respondents reported their preoperative assessment form does not have a space to document herbal supplement use. Only 30% of the CRNAs reported performing the preoperative evaluation themselves, 43% reported that anesthesiologists complete the preoperative evaluations, and 27% reported another CRNA, RN, or physician performs the assessment. When a preoperative assessment was performed by another person, 77% of CRNAs stated they review these evaluations with the patient before administering anesthesia.

• *Herbal supplement–anesthesia interactions.* The majority of CRNAs thought that herbal supplements could enhance the health of patients who use them (69%). Of the survey respondents, 92% overwhelmingly agreed that herbal supplements should be evaluated preoperatively, 88% thought that herbal supplements are medically active, and 87% thought that herbal supplements have an impact on surgical outcomes.

• *Herbal supplement use.* Nearly 4 of 10 participants identified themselves as users of herbal supplements. Approximately 31% would recommend herbal supplements to friends and family, whereas only 5% would recommend them to patients. Only 17% of respondents reported they discourage the use of herbal supplements by friends or family, and 13% discourage patient use of herbal supplements.

• *Confidence of herbal knowledge.* Confidence in herbal supplement knowledge was minimal, with only 17% of participants feeling confident in their overall knowledge base of herbal supplements and their inter-

**Figure 2. CRNA confidence in familiarity with herbal supplement anesthesia interactions expressed as a percentage of the total survey respondents (n = 191)**



action with anesthesia. When the 8 herbal supplements were identified individually, 3 of 4 participants felt confident in their familiarity with Ephedra's side effects, uses and anesthesia implications. Confidence fell drastically for the other supplements (Figure 2).

• *Knowledge assessment.* The lack of confidence in familiarity with the 8 herbal supplements was reflected in low scores in the survey's knowledge section. Correct responses to the individual knowledge questions ranged from 82.2% and 54.5% correct for the Ephedra questions to only 7.9% and 4.2% correct for the ginseng questions (Table 2). When the correct responses for the 2 knowledge questions for each supplement were combined, CRNAs demonstrated more knowledge about Ephedra (see Table 2). Both of the Ephedra knowledge questions were answered correctly by 68.4% of the CRNAs. Garlic had the next highest number of correct responses, but only 26.2% of the CRNAs correctly answered the 2 garlic knowledge questions.

The mean correct score was 3.4 of a possible 16 questions or 21% (SD 2.8). When the knowledge scores were recalculated omitting the 2 questions about Ephedra, the mean score fell to 2.1 of 14 questions or 15% (SD 2.4). As shown in Figure 3, when questions regarding Ephedra were removed from the knowledge section, 34% of all CRNA participants did not correctly identify any herbal knowledge questions. Only 23% correctly identified the ASA's recommendation of discontinuation of herbal supplements 2 weeks before surgery.

**Table 2. Percentage of CRNAs correctly answering herbal-specific survey questions (n = 191)**

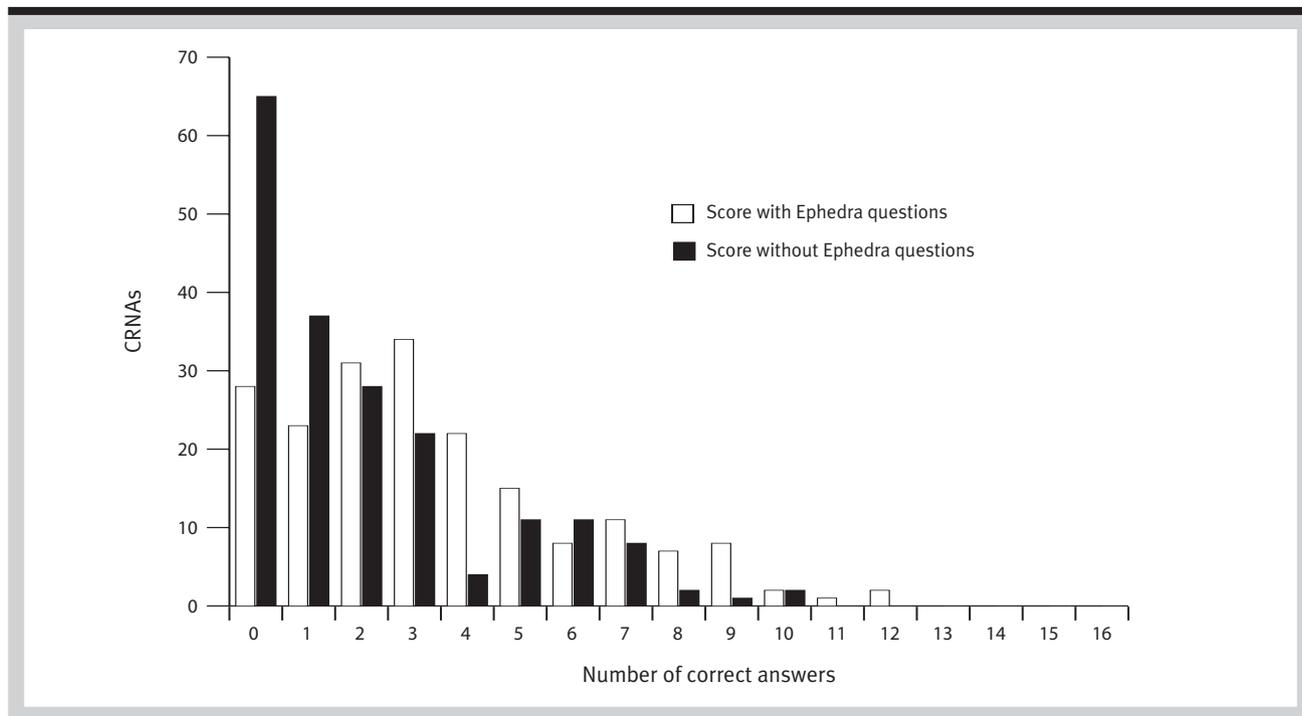
Herbal supplement knowledge questions		CRNAs correctly answering individual herbal knowledge questions (%)	CRNAs correctly answering both individual herbal knowledge questions (%)
Ephedra	1	82.2	68.4
	2	54.5	
Echinacea	1	15.2	11.6
	2	7.9	
Garlic	1	39.3	26.2
	2	13.1	
Ginkgo biloba	1	10.5	19.4
	2	28.3	
Ginseng	1	7.9	6.1
	2	4.2	
Kava kava	1	7.9	6.2
	2	8.4	
St John's wort	1	33.0	20.2
	2	7.3	
Valerian root	1	13.1	12.6
	2	12.0	

• *Relationship between demographic characteristics and knowledge scores.* The *t* tests for independent samples revealed that users of herbal supplements scored significantly higher than nonusers in the knowledge section ( $P = .021$ ); however, the mean score of 4.0 (SD 2.8) for users was not much better than the mean score of 3.0 (SD 2.6) for nonusers. Nonusers were significantly more likely to select "I don't know" as an answer in the knowledge section than users (63% vs 49%;  $P = .002$ ). There were no differences in knowledge scores or in choosing "I don't know" between men and women. Similarly, there were no differences in knowledge scores for age or years practicing as a CRNA.

When comparing knowledge scores by location of practice, there were significant differences in the scores (mean scores: hospitals, 3.2; academic settings, 3.6; and other settings, 4.6; 188;  $P = .039$ ). Posthoc analysis using the Scheffe test found that the differences were significant only between hospitals and other practice settings. No significant differences in knowledge scores were found between respondents from urban, suburban, or rural practice settings.

Although few respondents reported confidence in their knowledge or had high knowledge scores, the overwhelming majority (93%) of CRNAs revealed a desire to gain knowledge about herbal supplements.

**Figure 3. Correct scores on knowledge section with and without Ephedra questions**



The majority of respondents reported they learned about herbal supplements through continuing education (76%). Other methods of gaining education included coworkers (47%), media (42%), friends or family (28%), and family physician (4%). Survey respondents (13%) identified other sources of herbal supplement education, such as the Internet, pharmacies, and homeopaths.

### Discussion

The results of this study were similar to those of Silverstein and Spiegel<sup>16</sup> revealing a lack of provider knowledge with respect to herbal supplement interactions. The authors of that study identified lack of education and limited exposure as possible reasons for the low scores. Lack of exposure and education is also a potential explanation for the low scores in our CRNA sample. Participants who identified themselves as users of herbal supplements scored significantly higher on the knowledge section than did the nonusers. This suggests increasing exposure to herbal supplements could lead to increased knowledge and awareness. However, the scores for CRNA users of herbal supplements were still quite low, suggesting there is a great need for education about herbal supplement interactions in the surgical setting.

Although CRNAs believe herbal supplements have an impact on surgical outcomes, they indicate a substantial lack of confidence and knowledge about

herbal supplement implications in the anesthesia setting. This lack of confidence and knowledge was not attributable to age, gender, urban or rural practice, or years practicing as a CRNA. CRNAs felt most confident in familiarity with interactions and indications of the supplement Ephedra, which is similar to the medication ephedrine, used extensively in the anesthesia setting. This confidence was reflected in the notably better scores for knowledge questions about Ephedra compared with other supplements. The 2 Ephedra items were identified correctly by more than two thirds of participants, but only about 1 in 4 CRNAs or fewer correctly identified the effects of any of the other herbal supplements. Regular exposure to the medications that are similar to Ephedra may possibly explain this difference. If CRNA exposure to other herbal supplements and their anesthesia interactions is increased, confidence and knowledge may also increase.

Surprisingly, the majority of the CRNAs reported their preoperative evaluation forms do not have a listed assessment of herbal supplement use. This may indicate that hospitals and anesthesia departments do not believe herbs have an impact on anesthesia. Only 30% of the CRNAs surveyed perform the preoperative patient assessment. These obstacles could lead CRNAs to believe that they have minimal control and impact on patient evaluations.

Given the results of this survey, it would seem the current ASA position regarding herbal supplements

has not reached the practicing CRNA population. Fewer than one fourth of the participants correctly identified the ASA recommendation to discontinue herbal supplements 2 weeks before surgery. If this recommendation is to become a standard of practice, it is essential that practicing CRNAs and providers who perform preoperative assessments are aware of it.

An overwhelming majority of CRNAs who completed the survey indicated a desire for more education about herbal supplements. All of the participants, regardless of years in practice, strongly agreed that more education was necessary. This suggests that both review of current anesthesia educational curricula and additional continuing education opportunities are necessary to ensure adequate herbal knowledge. Anesthesia educators and conference coordinators need to be cognizant of this desire for knowledge and include herbal supplement information in their program agendas.

• *Limitations and strengths.* This study included only practicing CRNAs registered in 2002 with the AANA. Nurse anesthesia students, AANA members in other membership categories, anesthesiologists, and anesthesia residents are not represented in this study, so results cannot be generalized to them. The length of the survey, timing of survey delivery, and lack of follow-up may have contributed to the low response rate. In addition, this self-report survey may not accurately reflect the true practices of the participants.

Although the response rate was low, the demographics of this random sample were quite similar to the overall AANA 2002 membership. Respondents were distributed across the range of ages and years in practice, and more than 84% of the states in the United States were represented in the sample. This is the first study performed that assesses CRNA knowledge and beliefs regarding herbal supplements in the surgical setting.

• *Future research and implications for practice.* Herbal supplements have been used medicinally for many centuries in Eastern cultures, but only in the past few decades have herbal supplements become popular in mainstream Western cultures. Western medicine providers are just now beginning to understand the effects herbal supplements may have on surgical outcomes when combined with pharmaceuticals. Continued research into herbal supplement interactions is paramount to increasing patient safety and provider knowledge. Standardization and regulation of herbal supplements could assist the scientific research needed to fully understand the impact herbal supplements have in the surgical setting. Because emerging research is linking herbal supplement use to possible adverse outcomes in the surgical setting, it is

imperative that anesthesia providers be aware of these possible interactions to provide safe anesthesia.

CRNAs usually are not the healthcare providers charged with patient preoperative education. Based on the survey response, preoperative assessments also are performed by anesthesiologists and other healthcare providers. Future studies should include knowledge, beliefs, and assessment of herbal supplement use for anesthesiologists, surgeons, family physicians, and preoperative nurses who perform preoperative evaluations. Awareness of herbal supplement interactions must be conveyed to patients before the day of surgery to avoid cancellations or delays and minimize risks in surgery.

Since the completion of this study, several educational articles have been published on the topic of herbals and how they can affect the course of anesthesia. These articles have been published in journals widely read by CRNAs.<sup>18-21</sup> With the increased attention on the topic, it would be of interest to re-survey CRNAs in the near future regarding their knowledge of herbal supplements.

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