

## California Dental Hygienists' Knowledge, Attitudes and Practices Regarding Herbal and Dietary Supplements

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### Introduction

The use of herbs and other natural products has been part of human culture for thousands of years, and people continue to use them to treat illness or improve health and well-being. Besides prayer, herbal and dietary supplements (HDS) are the most widely used complementary and alternative medicine (CAM) therapies in the U.S.<sup>1</sup> Many Americans regularly use HDS on a daily or weekly basis. It is estimated that more than half of the adult population in the U.S. (nearly 114 million) consume dietary supplements.<sup>2</sup> The term dietary supplement includes herbs and botanicals as well as vitamins, minerals and other nutritional supplements. The federal government defines a dietary supplement as "a product (other than tobacco) that is intended to supplement the diet that bears or contains one or more of the following dietary ingredients: a vitamin, a mineral, an herb or other botanical, an amino acid, a dietary substance for use by man to supplement the diet by increasing the total daily intake, or a concentrate, metabolite, constituent, extract or combinations of these ingredients."<sup>3</sup>

American adults who consume HDS report taking 1 or more per day.<sup>2,4-12</sup> Further, among patients that use HDS, a large percentage (41 to 70%) do not report their use to their primary care physician or even anesthesiologist.<sup>13-16</sup> Among Americans who reported the use of HDS to a health care provider, the vast majority informed their physician while only 3% reported use to their den-

### Abstract

**Purpose:** As more Americans use dietary supplements, the potential for increased adverse effects increases. The purpose of this study was to identify the current knowledge, attitudes and practice behaviors among California dental hygienists regarding herbal and dietary supplements (HDS).

**Methods:** A stratified random sample of 1,203 registered California hygienists were surveyed. The survey included items about personal characteristics as well as questions regarding knowledge, attitudes and beliefs and practice behavior about HDS. Three primary outcomes were analyzed: dental hygienists' knowledge about HDS, attitudes (confidence) about HDS and behavior practices (communication) regarding HDS. Confirmatory factor analysis was performed. Personal characteristics were assessed in stepwise multiple linear regression analysis for impact on knowledge scores.

**Results:** The response rate was 21% (n=249). Dental hygienists have low levels of knowledge and confidence about HDS, as well as poor communication practices related to HDS. California dental hygienists scored a low mean of 38% on their knowledge of HDS. On the confidence scale (standardized range of 0 to 10 possible), hygienists scored 3.67±2.03. On the communication practices subscales (standardized range of 0 to 10 possible), hygienists scored 4.21±2.99 on general communication practices and 1.25±1.66 on specific communication practices. Dental hygienists who were members of the California Dental Hygienists' Association and attended a continuing education course on HDS within the last year or who personally used HDS scored significantly higher in knowledge, confidence and communication practices than their counterparts. These 3 attributes were identified as significant predictors for higher knowledge about HDS.

**Conclusion:** There is a need to improve California dental hygienists' knowledge and involvement in the active management of patients who take HDS. Such actions can be expected to improve oral health outcomes. Focused training on HDS for hygienists should be designed to improve their knowledge and influence practice behaviors.

**Keywords:** Dietary supplements, Herbal supplements, Dental hygienists' knowledge attitudes and practices

This study supports the NDHRA priority area, **Clinical Dental Hygiene Care:** Investigate how dental hygienists use emerging science to reduce risk in susceptible patients (risk reduction strategies).

tist.<sup>16</sup> Even more concerning, among adults with chronic or serious diseases, such as those affecting oncologic, neurologic, rheumatologic, cardiac, vascular, endocrine, gastrointestinal or pulmonary conditions, less than half reported using HDS to their regular health care provider.<sup>17</sup> Dietary supplements are over-the-counter and not regulated by the Food and Drug Administration with the same scrutiny as conventional drugs.<sup>3</sup> Because HDS include many natural products, they typically do not contain single pharmacologically active constituents like drugs, but are composed of a complex mixture of potentially active ingredients. This has raised concerns about their efficacy and safety, especially in the case where patients use HDS and prescription drugs simultaneously.<sup>7,16,18,19</sup>

This concomitant use of HDS is widespread and has raised a growing medical concern over the potential for herb-drug interactions.<sup>20-25</sup> A survey found 15% of patients on prescription drugs were also taking herbal supplements. Among these, potential adverse herb-drug interactions were observed in 40% of patients.<sup>26</sup> The adverse reactions involved all systems, age groups and severity. Concurrent use of HDS and prescription drugs is also seen in dentistry. In dental patients, 54% used some form of herbal supplements. Of those, 69% were also using prescription drugs.<sup>27</sup> Herbal and dietary supplement use among Californians exceeds national statistics. In a follow up survey to the 2001 California Health Interview Survey, investigators asked specific questions regarding multivitamin and HDS use.<sup>28,29</sup> Of the 9,187 respondents, over 62% reported using 2 or more HDS in addition to a multivitamin to deal with a health problem. Without the knowledge of HDS use among patients, the health care provider will be unable to associate possible adverse effects and toxicities that may be caused by HDS. Given the large number of consumers using these supplements, dental hygienists should be aware of the use, safety and potential risks of HDS their patients may be taking.

### **Health Professional's Knowledge, Attitudes and Practices about HDS**

There is limited information about American health professionals' knowledge, attitudes or clinical practices related to HDS. In a cross-sectional survey of 537 clinicians, physicians, advanced practice nurses, pharmacists and registered dietitians, respondents demonstrated considerable room for improvement in knowledge of herbal medicine.<sup>30</sup> Most respondents correctly identified common clinical uses of popular herbs, such as St. John's wort, but despite reporting previous formal training on herbal supplements, most were unable to identify

adverse reactions and side effects associated with these herbs. Average knowledge across all groups was substantially less than 60% of possible scores, with registered dietitians scoring significantly higher than any other group. Attitudes of these clinicians revealed that 77% had used HDS themselves on a regular basis, and 79% agreed that many herbal supplements have some therapeutic benefit. Although most participants (64%) believed they knew more about herbal medicine than their colleagues, only 21% felt they could answer questions posed by their patients, and 17% knew how to report adverse effects to local or government agencies. In a 2006 follow up study, Kemper et al conducted the largest survey to date to examine expertise about HDS among diverse health professionals (physicians, nurses, nutritionists, dietitians, pharmacists and students).<sup>31</sup> Survey questions sought information on demographics and respondents' overall knowledge, attitudes (confidence) and communication practices. Of the 1,268 participants, 65.8% answered the knowledge test questions correctly, with pharmacists (70.7%) and physicians (70.3%) scoring higher than other groups. Although the authors concluded there was room for improvement in the area of confidence, dietitians had the highest confidence scores, followed by physicians, nurses, pharmacists and students. Those health professionals who were regular users of HDS scored higher in the communication practices section, making the authors conclude that higher use of these supplements among professionals affected the quality of information supplied to patients.

### **Dental Professional's Knowledge, Attitudes and Practices about HDS**

There has been no exclusive research on dental professional's knowledge, attitudes or practices regarding HDS. A survey of health professionals by Dougherty et al included dental faculty among the 904 surveys distributed.<sup>32</sup> Ninety-eight surveys were sent to dental faculty, with 60 returned (61.2% response rate). There was no description on whether the participants were dentists, dental hygienists, dental assistants or other dental personnel. Personal use of HDS among dental school respondents was 31.6% (n=19), considerably lower than the national average of 52% during the same time period.<sup>10</sup> Dental faculty involved in direct patient care who recommended herbal medicine was 13.3% (n=4), the lowest reported among the groups surveyed. As with previous surveys of health professionals, this survey revealed that respondents who regularly used HDS themselves were more likely to recommend herb use to patients (p<0.001). No knowledge questions were asked in the survey, however, respondents who used HDS themselves

were more likely to teach students about herbal medicine ( $p=0.001$ ). In addition, the study reported 6.8% ( $n=26$ ) of respondents planned to expand teaching about herbal medicine during the following academic year, with only a small percentage of dental faculty planning to do so.

The case for change in dental education has suggested that significantly more curricular attention should be devoted to graduating professionals who are capable of dealing with the changing health demographics of the population, as well as patient/population desires, needs and expectations.<sup>33-35</sup> The increasing popularity of HDS demands that dentists and dental hygienists be knowledgeable about the effects of these supplements in order to make appropriate treatment modifications. This includes obtaining important information from patients as well as educating patients about the risk-benefit and potential interactions that could be seen with HDS. The entry-level and current practitioner needs to have the knowledge and attitudes necessary to be able to provide the comprehensive care that exists in dental and dental hygiene practices today. The purpose of this study was to identify the current knowledge, attitudes and practice behaviors among California dental hygienists regarding HDS.

## Methods and Materials

### Survey Instrument Development

A 4 part survey, previously conducted among a diverse group of health professionals (physicians, nurses, nutritionists, dieticians, pharmacists and respective professional students) was modified and used with permission from the authors.<sup>31</sup> The questionnaire included 3 sections designed to assess knowledge (29 items), attitudes (20 items) and practices (15 items) about HDS, and a fourth section assessing professional characteristics and demographics. Instructions to participants reminded them of their anonymity with regard to survey responses. In the knowledge section, participants were directed to complete the questions to the best of their ability and to use no outside resources.

Modifications to the original instrument were slight and in some cases related to wording that clarified the question. Three questions were added in the first section dealing with respondent's practice of seeing patients and whether or not they had attended a continuing education course on HDS. One question was added to the second and third sections of the survey. Demographic questions were modified in the fourth section to be specific with the practice of dental hygiene and included a question regarding whether or not the respondent was

a member of the California Dental Hygienists' Association. Approval for the survey was secured from the Social Science Institutional Review Board (IRB) of the University of Missouri-Kansas City. Because the primary investigator and a secondary investigator are faculty at Loma Linda University, the Loma Linda University IRB was informed. The survey instrument was piloted to a group of clinically practicing dental hygienists ( $n=12$ ) who identified confusion on some questions. Based on the feedback, the wording of 3 questions was changed prior to the release of the final questionnaire.

### Scales Development

The original study reported face validity and excellent Cronbach's alpha reliability statistics for the 2 scales that measured attitudes (confidence) and communication practices (0.96 and 0.84 respectively).<sup>31</sup> It is generally agreed a Cronbach's alpha reliability statistic of 0.70 is acceptable, with values closer to 1.0 indicating stronger internal consistency of the instrument.<sup>36,37</sup> For this study, scales to measure confidence and communication practices were created using the same criteria as in the original study in order to make comparisons. In addition to determining the Cronbach's alpha of the new scales, confirmatory factor analysis was performed to validate the scale by determining if the items in the scale were correlated. A confidence scale was created to measure dental hygienists' attitudes and beliefs related to HDS using all 20 questions posed to determine attitudes and beliefs from the second section of the questionnaire. Confirmatory factor analysis of the 20 questions revealed that 1 question did not load on the same factor and was therefore removed from the scale. This resulted in a single factor consistent scale, as its constituent items loaded on the same factor. As in the original study, a raw score was generated by assigning a value to the answers of the remaining 19 attitude and belief questions, with 0 (strongly disagree) to 4 (strongly agree), with a minimum possible score of 0 and a maximum possible score of 76. A communication practices scale was created to measure dental hygienists' practice behaviors related to their communication with patients regarding HDS. As in the previous study, a raw score was generated by assigning a value to the answers of the 7 questions dealing with communication practices found in the first section of the questionnaire. The original communication practices scale used 11 items from the first section.<sup>31</sup> It was determined to not include 2 yes/no questions or 2 contingency questions, where the respondent only answered these 2 questions if they responded positively to a previous question. The questions were scored as a proportion corresponding to the percentage chosen (0.0 to 1.0).

Those that answered 0% were assigned a score of 0, those that answered 1 to 30% received a score of 0.25, 31 to 50% received a score of 0.5, 51 to 80% received a score of 0.75 and >80% received a score of 1.0. The possible range of raw scores for this scale was 0 to 7. Confirmatory factor analysis of these 7 questions revealed this scale was not a single factor consistent scale, as its constituent items loaded on 2 different factors. It was determined that for this study, 2 subscales were required to measure communication practices of dental hygienists. The first subscale would contain 3 of the 7 questions and measured general communication practices (GCP), with possible range of raw scores from 0 to 3. The second subscale would contain the remaining 4 of the 7 questions and measured specific communication practices (SCP), with possible range of raw scores from 0 to 4. In order to make comparisons easier to view, all 3 new scales were standardized to a scale of 0 to 10, with 0 being the lowest.

## Participants

A sample of 1,203 registered dental hygienists actively licensed and residing in California were randomly recruited from a dental hygiene mailing list of 14,378 obtained from the California Dental Hygienists' Association (CDHA). A stratified random sample across 25 California geographic regions, represented by the 25 local California Dental Hygienists' Association component organizations, was used in this study. An announcement postcard was mailed to all selected dental hygienists informing them of their selection and inviting them to complete the anonymous survey online. If the dental hygienist desired to complete the survey online, instructions were provided on the postcard to send an email to Loma Linda University Health Consulting Group with the word "herbal" in the subject heading. To help ensure anonymity, an automatic response was generated back which included a link to the survey online. The participant was required to enter a unique 4 digit code from the postcard mailing label, which automatically removed the participant's address from the mailing list. Ten dental hygienists took advantage of the online survey. Three weeks following the mailing of the announcement postcard, the survey was mailed to the remaining 1,193 selected dental hygienists who did not respond to the online invitation. Six weeks following the mailing of the announcement postcard, a reminder postcard was mailed to all 1,193 selected dental hygienists.

## Statistical Analysis

Three primary outcomes were analyzed: dental hygienists' knowledge about HDS, attitudes (con-

fidence) about HDS and communication practices regarding HDS. Descriptive statistics were generated using means and standard deviations for numeric values. Group comparisons were made using the Mann-Whitney U test or Kruskal-Wallis ANOVA because some numeric data were not normally distributed. Associations were explored by using the Spearman's rho coefficient to determine any correlations between knowledge, attitudes, practices and personal characteristics of dental hygienists. A multiple variable regression model to investigate independent association between the number of HDS personally used by dental hygienists during a typical week, whether dental hygienists attended a continuing education course on HDS within the previous year and if dental hygienists were members of the CDHA, was used with knowledge scores. Confirmatory factor analysis on the scales used to measure confidence and communication practices was conducted using Quartimax with Kaiser Normalization because this rotation method maximizes similarities and minimizes differences among factors.

## Results

Of the 1,193 surveys mailed, 12 surveys were undeliverable despite attempts to forward to an alternate address. A total of 250 surveys were returned (10 completed electronically, 239 completed by mail, 2 surveys were returned by mail with notes from the respondents stating they were not qualified to complete the survey and 1 mailed survey was received after survey analysis was being conducted and was never opened). The response rate was 21%. Of the 249 respondents who completed the survey, 97% were female and 3% were male. The respondents were evenly split with regard to membership in the CDHA, with 49% reporting being a member (n=122). Most respondents reported working in a general practice (80%), while 10% (n=24) reported they were not currently practicing dental hygiene. Although 48% (n=119) reported a bachelor's degree as their highest level of college degree attained, only 40% (n=99) reported a Bachelor of Science degree in dental hygiene. An Associate of Science degree in dental hygiene was the highest level of dental hygiene degree held by a majority of respondents (55%). Only 2 respondents reported a Master of Science degree in dental hygiene (0.8%), while 5% of the dental hygienists indicated a master's degree or higher as their highest level of education. Most respondents (n=213, 86%) reported they had not attended a continuing education course on HDS in the last year (Table I). Overall, 88% (n=220) described themselves as having had professional contact with a patient in the previous 30 days of participation, with 12% (n=29) reporting no professional contact with a

patient. Respondents who reported professional contact with a patient in the previous 30 days were asked to complete all sections of the survey to include communication practices regarding HDS, attitudes and beliefs about HDS, knowledge of HDS as well as personal use of HDS and demographic information. The clinicians were also asked to estimate the number of hours they worked in patient care each week, the number of patients they saw per week and how many of their patients took HDS (Table II). Those respondents who did not have professional contact were directed to complete only 2 sections of the survey dealing with their knowledge about HDS as well as demographic information that included their personal use of HDS. A majority of respondents (n=198, 80%) reported using HDS themselves in a typical week. The range of supplements used was 1 to 30 per respondent per week, with an average of  $5.75 \pm 4.74$ . The most common HDS supplements used included calcium, multivitamin and Omega 3 fish oil. Among herbal supplements, green tea and flax seed were the 2 most popular botanicals reported (Table III).

### Knowledge scores

The knowledge questions included 13 true/false items and 16 multiple choice questions about the use and safety of commonly used HDS, such as black cohosh, ginger, chromium, fish oil, ginkgo biloba, glucosamine and St. John's wort. Knowledge scores were reported by percent of the knowledge questions answered correctly, and all 29 questions allowed for the respondent to choose "I don't know" as a response option. The scores ranged from a low of 4% to a high of 90%, with an average score of 38% of the knowledge questions answered correctly. The Cronbach's alpha reliability statistic of the knowledge score was 0.87. Over half of the time (55%), dental hygienists chose the response "I don't know" in this section of the survey, indicating a lack of knowledge about HDS. All dental hygienists (n=247, 100%) selected this answer option at least once, ranging from a low of 1 respondent selecting this option once to a high of 4 respondents selecting this option for all 29 questions. Those dental hygienists who did not attend a continuing education course within the last year chose this answer option 15% more often ( $p < 0.001$ ) than their counterparts who indicated they attended a continuing education course on HDS.

The vast majority (78%) correctly identified that glucosamine is useful in treating osteoarthritis, while over half (51%) recognized that black cohosh is useful to treat hot flashes in women and is approved by the German Commission E. Most dental hygienists (72%) noted that ginger can be

Table I: Personal Characteristics of Respondents to CA HDS Survey (n=249)

Gender	
Male	8 (3.2%)
Female	241 (96.8%)
Age	
20-30	24 (10%)
31-40	50 (20%)
41-50	66 (26%)
51-60	67 (27%)
61-70	35 (14%)
71+	7 (3%)
Highest DH Degree Earned	
Certificate	10 (4%)
Associate of Science	138 (55%)
Bachelor of Science	99 (40%)
Master of Science	2 (1%)
Highest College Degree Earned	
Associate degree	117 (47%)
Bachelor degree	119 (48%)
Master degree	11 (4%)
Doctorate degree	2 (1%)
Practice Setting	
General	199 (80%)
Periodontics	11 (4%)
Education	6 (2%)
Public Health	3 (1%)
Corporate	1 (.5%)
Consultant	1 (.5%)
Other	4 (2%)
Not currently practicing	24 (10%)
California Dental Hygienists' Association Membership (n=245)	
Yes	122 (49%)
No	123 (49%)
Missing	4 (2%)

Table II: Clinician Characteristics of California HDS Survey (n=220)

Patient Contact in Preceding 30 days	
Yes	220 (88%)
No	29 (12%)
Average Clinical Hours Worked per Week	26.38 ± 9.44 hours
Average Patients Seen During Week	27.55 ± 10.58 patients
Estimates of Patient Weekly Use of HDS	
0%	1 (0%)
1%-30%	99 (45%)
31%-50%	50 (23%)
51%-80%	61 (28%)
>80%	9 (4%)

an effective remedy for nausea and 57% were able to identify among a list of herbs (chamomile, peppermint, cranberry and ginger) that cranberry would be the exception in treating an upset stomach. Seventy-four percent of dental hygienists knew that St. John's wort is typically used to treat depression, but few (20%) knew that St. John's wort can change serum concentrations of digoxin. Few dental hygienists (4%) knew that chromium is ineffective in normalizing serum glucose and Hg-bA1c levels in patients with diabetes, and 88% did not know that American ginseng shows promise in reducing postprandial (after meal) glucose levels. Only 35% knew that riboflavin (Vitamin B2) is associated with angular cheilitis, but over half (54%) knew that ginkgo could increase the risk of bleeding.

There were no significant differences noted between knowledge scores and gender ( $p=0.124$ ), highest dental hygiene degree earned or highest total college education ( $p>0.05$ ) and practice setting where hygienists worked most often ( $p>0.05$ ). Those dental hygienists who attended a continuing education course within the last year on HDS scored 13% higher ( $p<0.001$ ) on the knowledge questions than those who did not. In addition, those dental hygienists who were members of the CDHA scored 7% higher in their knowledge scores ( $p=0.002$ ) than those that were not CDHA members (Table IV). Using the Spearman's rho coefficient, a significant positive linear correlation between knowledge scores and the number of HDS personally used by dental hygienists was found ( $r=0.365$ ,  $p<0.001$ ). Not surprisingly, this analysis confirmed the more HDS used weekly by dental hygienists, the higher they scored in the knowledge section. A statistically significant positive correlation was also found between knowledge scores and membership in the CDHA, and whether the dental hygienist attended a continuing education course on HDS within the last year. There was no significant correlation found between the age of the dental hygienist and knowledge scores ( $r=0.001$ ,  $p=0.987$ ) or gender of the dental hygienist and knowledge scores ( $r=-0.096$ ,  $p=0.135$ ). Three independent predictors of high HDS knowledge were identified among dental hygienists (Table V):

1. Personal use of HDS
2. Attendance at a continuing education course on HDS within the last year
3. Membership in the California Dental Hygienists' Association

### Attitudes (Confidence) Scores

Attitudes and beliefs regarding HDS were

Table III: California Dental Hygienist Herbal and Dietary Supplement Use

Type of HDS	n=249
Overall Mean weekly use $5.75 \pm 4.7$	
Nutritional Supplements	
Calcium	139 (56)
Multiple vitamin	133 (53)
Fish Oil/Omega 3	91 (37)
Vitamin D	75 (30)
Vitamin C	71 (29)
Vitamin B complex	63 (25)
Vitamin E	50 (20)
Glucosamine sulfate	42 (17)
Coenzyme Q 10	31 (12)
Herb/Botanical Supplements	
Green tea	65 (26)
Flax seed	52 (21)
Chamomile	27 (11)
Echinacea	15 (6)
Soy	14 (6)
Cranberry	11 (4)
Garlic	10 (4)
Aloe vera	10 (4)

Data is presented as mean  $\pm$  standard deviation or n (%)

gained from those dental hygienists who had professional contact with patients in the previous month ( $n=220$ ). Responses to 20 Likert-type questions (strongly disagree, disagree, neutral/not sure, agree, strongly agree) reflected the respondents' overall confidence with HDS that their patients may be taking.

Sixty-nine percent of dental hygienists agreed they could readily record information about their patient's use of HDS in the patient record, yet only 21% agreed they knew how to ask about which brands and doses of HDS patients were using. Although only 25% felt confident responding to patient's questions about HDS, 37% reported they were confident initiating discussions with patients about HDS. Only 19% felt they could warn patients about side effects of commonly used HDS, 18% felt they could warn patients about interactions between commonly used HDS and medications and 7% knew how and where to report adverse effects related to HDS. Although 31% felt they knew where they could find reliable information about HDS for themselves, only 18% knew where to refer patients for more information about HDS, and just 11% agreed they could provide evidence-based information about HDS to patients. Most dental

hygienists were not comfortable providing information to students, with 78% reporting they could not teach a high school science class about HDS, and 74% feeling they could not give a lecture about HDS to dental hygiene students. Only 8% felt confident their dental hygiene education prepared them to manage patients using HDS.

This study revealed a low confidence scale score ( $3.67 \pm 2.03$ ) among dental hygienists regarding HDS. The Cronbach's alpha reliability statistic for this scale was 0.95. Mann-Whitney U test revealed no statistically significant difference seen between the confidence scale score and gender, age, CDHA membership or highest dental hygiene degree earned. Kruskal-Wallis ANOVA revealed no significant difference between the confidence scale score and highest overall college degree earned (Table VI). Spearman's rho coefficient analysis revealed a significant positive linear correlation between the number of HDS used by respondents weekly and the confidence scale score ( $n=220$ ,  $r=0.304$ ,  $p<0.001$ ), as well as whether the respondent had attended a continuing education course on HDS within the last year ( $n=220$ ,  $r=0.194$ ,  $p<0.001$ ). However, no correlation was seen with membership in the California Dental Hygienists' Association (Table V).

### Communication Practices Scores

Scores for communication practices of California dental hygienists were acquired from respondents who had professional contact with patients in the previous 30 days prior to completing the survey ( $n=220$ ). Responses to 15 questions dealing with professional practices regarding patients and HDS revealed dental hygienists' practice behaviors. These questions asked respondents to choose how often they completed certain practice behaviors with patients, ranging from 0%, 1 to 30%, 31 to 50%, 51 to 80% and >80%.

The majority of dental hygienists (77%), in half their patient encounters, did not question patients about their use of HDS, with 23% reporting they asked about HDS use more than half of the time. Dental hygienists were equally as reluctant to initi-

Table IV: California Dental Hygienists' Knowledge of HDS

Characteristic	Percent Knowledge Items Correct (range 4 to 86%)
Gender	
Female	38% $\pm$ 18.0
Male	28% $\pm$ 13.4 NS
	$r=0.001$ $p=0.987$
Age	$r=0.001$ $p=0.987$
Number of HDS used weekly	$r=0.365$ $p<0.001$
Attended CE in past year	
Yes	49% $\pm$ 15.4
No	36% $\pm$ 17.7 $p<0.001$
California Dental Hygienists' Association Membership	
Yes	41% $\pm$ 17.04
No	34% $\pm$ 18.06 $p=0.002$

Data is presented as mean  $\pm$  standard deviation or Spearman's rho based on 29 knowledge questions

Table V: Predictors of Knowledge About HDS in a Linear Regression Model

Predictor	Coefficient	p value
Personal use of HDS	0.299	0.002
Attending a CE on HDS*	2.55	0.015
Membership in California Dental Hygienists' Association*	1.53	0.047

\*No=reference group

Age and gender were not significant predictors

ate discussion about HDS, as 64% reported starting the conversation with their patients in 30% or less of their patient encounters. Approximately half (51%) never asked patients they knew were using HDS about amount and frequency (dose) of the HDS, and even more (73%) never asked about the brand name or manufacturer of the HDS their patients were using. The vast majority of the dental hygienists (82%), who knew their patients were taking HDS, asked about side effects 30% or less of the time. Only 38% of dental hygienists reported documenting their patient's use or non-use of HDS in greater than 80% of their patient encounters during the preceding 30 days of practice. Most dental hygienists (70%) did not caution patients about the potential hazards associated with HDS use, and 88% did not provide any patient handouts or refer patients to specific books, articles or web sites for additional information.

This study revealed low general and even lower specific communication practices among dental hygienists. The mean GCP scale score among den-

Table VI: Confidence and Communication Practices Scales Scores Among California Dental Hygienists

Characteristic	Confidence (Attitudes) Scale (standardized range 0–10)	General Communication Practices Scale (standardized range 0–10)	Specific Communication Practices Scale (standardized range 0–10)
Overall	3.67 ± 2.03	4.21 ± 2.99	1.25 ± 1.66
Gender*			
Female	3.66 ± 2.02	4.27 ± 3.00	1.26 ± 1.67
Male	3.99 ± 2.20 NS	2.60 ± 1.92 NS	0.77 ± 1.09 NS
California Dental Hygienists' Association Membership*			
Yes	3.79 ± 2.06	4.35 ± 3.03	1.38 ± 1.93
No	3.55 ± 1.98 NS	3.95 ± 2.89 NS	1.08 ± 1.30 NS
Highest dental hygiene degree*			
Certificate & Associate	3.78 ± 2.06	4.15 ± 3.03	1.24 ± 1.72
Bachelor +	3.48 ± 1.96 NS	4.32 ± 2.93 NS	1.26 ± 1.54 NS
Highest College degree**			
Associate	3.47 ± 2.00	3.90 ± 2.98	1.00 ± 1.37
Bachelor	3.83 ± 1.97	4.54 ± 2.97	1.49 ± 1.90
Master+	4.53 ± 2.79 NS	4.42 ± 3.19 NS	1.62 ± 1.72 NS
Number of HDS used weekly***	r=0.304 p<0.001	r=.0207 p=0.002	r=0.270 p<0.001
Age***	r=0.002 NS	r=-0.48 NS	r=-0.30 NS

\*Mann–Whitney U

\*\*Kruskal–Wallis ANOVA

\*\*\*Spearman's rho

tal hygienists was 4.20±2.99. The mean SCP scale score was 1.25±1.66 (Table VI). The Cronbach's alpha reliability statistic for the GCP scale was 0.78, while the Cronbach's alpha reliability statistic for the SCP scale was 0.71. Mann–Whitney U revealed no statistically significant difference seen between either communication practices scale scores (GCP or SCP) and gender, age, CDHA membership and highest dental hygiene degree. Kruskal–Wallis ANOVA revealed no significant difference between highest total college degree earned and either the GCP or SCP. Spearman's rho coefficient analysis revealed a significant positive linear correlation between the number of HDS used weekly and the GCP scale score (n=218, r=.207, p=0.002), as well as for the SCP scale score (n=218, r=.270, p<0.001) (Table VII).

This study also revealed a significant positive correlation between knowledge scores, confidence scores and communication practices scores. Those respondents who scored higher in knowledge also scored higher in confidence and communication practices. In addition, those dental hygienists who personally used HDS had higher confidence and communication practices scores (both GCP and SCP), as well as higher knowledge scores, with the highest scores for those dental hygienists using >9 supplements per week (Table V).

## Discussion

This is the first study to describe the knowledge, attitudes (confidence) and communication practices of dental hygienists regarding HDS. Survey respondent demographics appear closely to represent the population of California dental hygienists. The current sample was mostly female (96.8%), which is consistent with previous reports that 97.5% of dental hygienists in the state were female.<sup>38</sup> The educational attainment of dental hygienists in this study was slightly higher than a previous California survey, with 47% of respondents reporting a bachelor's degree as their highest college degree attained, and 5% reporting a master's degree or higher compared to 43.2% and 4.6% in a previous study, respectively.<sup>38</sup> Most dental hygienists reported they were in clinical practice, working in general dentistry or periodontics (84%). This is down from a previous survey reporting 97.8% working in a private dental practice.<sup>38</sup> This downturn could be related to the increased number of dental hygienists working outside traditional private practice.

Dental hygienists reported higher personal use of HDS (80%) when compared with the only other study that looked at dental professionals (31.6%).<sup>32</sup> However, this was slightly lower when



Table VII: Spearman's Correlation Matrix Related to California HDS Survey Results

	Knowledge	Confidence	General Communication Practices	Specific Communication Practices	Number HDS Used	CDHA Membership
Knowledge						
Confidence	0.453**					
General Communication Practices	0.321**	0.349**				
Specific Communication Practices	0.303**	0.534**	0.546**			
Number of HDS used	0.365**	0.304**	0.207**	0.270**		
CDHA Membership	0.200**	0.024 (p=0.723)	0.059 (p=0.387)	0.041 (p=0.551)	0.038 (p=0.549)	
Attended CE on HDS	0.244**	0.194**	0.158*	0.244**	0.193**	0.050 (p=0.474)

Data is presented as Spearman's rho  
 \*\*Correlation is significant at  $p < 0.001$   
 \*Correlation is significant at  $p < 0.05$

compared with other health professionals that included physicians, nurses, dietitians, nutritionists and pharmacists (85.1%) who completed a similar survey.<sup>31</sup> Despite the overall lower personal use of HDS, dental hygienists reported a higher median number of supplements used per week (5 supplements) than other health professionals (4 supplements).<sup>31</sup> Interestingly, among these health professionals who completed a similar study, multivitamins (64%) and calcium (39%) were the top 2 HDS personally used, compared to this study where calcium and multivitamins were the top 2 HDS used weekly among dental hygienists. Results also suggest this sample of dental hygienists from California may be more likely to take HDS than the general population. Previous studies report that 48 to 60% of Americans take dietary supplements.<sup>2,4-12</sup>

This survey was modified to allow the respondent to choose "I don't know" as an answer choice in the knowledge section, where other surveys of health professionals did not offer this alternative. The purpose of offering this choice was to remove a bias that favors random guessing with true/false and multiple choice questions. Research has demonstrated that more able respondents employ an intelligent guess, whereas less able respondents employ a random guessing approach.<sup>39-41</sup> By offering a choice of "I don't know," dental hygienists could choose this option if they had no knowledge of the topic and could not make an intelligent guess by using partial knowledge. In the study this survey

instrument was modified from, physicians, nurses, nutritionists and pharmacists scored nearly twice as well (65.8%) in knowledge compared to dental hygienists (38%).<sup>31</sup> This lower knowledge score could be viewed as a more reliable representation of what dental hygienists know or don't know – distortion or inflation of the knowledge scores would be reduced since respondents were not required to guess on any questions. Since 100% of dental hygienists chose this option at least once, this could account for the lower knowledge score. Another explanation of the low knowledge scores could lie in the nearly 87% of dental hygienists who had not attended a continuing education course on HDS within the last year. There was a strong correlation between high knowledge scores and dental hygienists who had attended a continuing education course on HDS within the last year. Half the respondents were not members of the CDHA, and analysis confirmed they had significantly lower knowledge scores than those dental hygienists who were members. California dental hygienists had lower mean confidence scores compared to other health professionals in a previous study ( $52.5 \pm 18.2$ , possible range 19 to 95).<sup>31</sup>

Most dental hygienists (81%) did not have confidence in their dental hygiene education preparing them to manage patients who take HDS, which could also contribute to the low knowledge scores. This confirms concerns that education that is meaningful and relative to current practice should be provided, and suggests a need for changes in

entry-level curriculum to include more information about HDS.<sup>33-35</sup> To address the already practicing dental hygienists, more continuing education courses focused on HDS should be made available as well. These continuing education courses should use mixed interactive and didactic formats, focusing on outcomes that are likely to be perceived as serious in order to raise the likelihood of improving knowledge and clinical practice behaviors.<sup>42</sup> Further research is needed to indicate exactly where formal training is taking place and the impact of training about HDS on changes in practice behaviors to improve patient safety. This lack of confidence translated into poor communication practice behaviors, with few dental hygienists asking their patients about HDS use, dosage or adverse effects. The vast majority (98%) had never reported a suspected adverse effect from an HDS to the FDA.

This study had several strengths and limitations. Strengths included the confirmatory factor analysis conducted on the scales which corroborated their consistent and reliable measurement of attitudes as it related to confidence and communication practices. The Cronbach's alpha of the scales and knowledge questions were acceptable, which demonstrated reliability. Limitations of this study included a small pilot test sample, as well as some bias that is seen in most surveys, as only those individuals who were interested in the topic may have responded. Even though respondents were instructed not to use any outside assistance or reference while answering the knowledge questions, it was impossible to determine if the instructions were followed. This study used self-report rather than observation of clinical communication practice behaviors, and the extent to which self-report correlated with actual clinical communication practices was unknown. California dental hygienists may not be representative of the general dental hygiene population as it relates to HDS use. Finally, this survey was long, and this could have contributed to the low response rate of 21%, which may limit the generalizability of the findings.

## Conclusion

Although there has been an increase in the number of continuing education programs, review articles and research available to interested dental professionals about HDS, there is still substantial room for improvement in knowledge, attitudes (confidence) and communication practices among California dental hygienists. Dental hygienists scored lower in knowledge, confidence and communication practices than other health professionals previously surveyed. Despite the limitations, this study offers important insights about the need for additional education of dental hygienists on clinical practice behaviors related to the management of patients who take HDS. Focused training for dental hygienists should be designed to improve knowledge and influence communication practice behaviors, which will ultimately improve general and oral health outcomes for patients. Future studies are necessary to address the impact of the lack of knowledge about HDS and how this issue could be addressed through future curricula and continuing education, as well as the influence of professional association membership. Given the enormous growth in the use of HDS in the U.S., dental hygienists need to be knowledgeable as well as comfortable discussing HDS with their patients. This study confirms the need for more education in the area of HDS to not only improve the knowledge base, but also the confidence and communication practices of dental hygienists.

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