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FLUORIDE VARNISH USE AMONG DENTISTS IN VIRGINIA

A thesis submitted in partial fulfillment of the requirements for the degree of Masters of Science in Dentistry at Virginia Commonwealth University.

by

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Abstract

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By Amanda Bowen Kuhn, B.S., D.M.D.

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Virginia Commonwealth University, 2008

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Purpose: The purpose of this study was to assess fluoride varnish use by dental practitioners in Virginia.

Methods: Using a cross sectional survey design, all dentists in Virginia who are members of the Virginia Dental Association (VDA) were sent an online survey about usage and knowledge of fluoride varnish.

Results: The majority of the respondents were general dentists (79%) followed by pediatric dentists (12%). Fluoride varnish use increased with year of graduation from dental school. Dentists who thought fluoride varnish was more effective and less time

consuming use it more than other topical fluorides. Dentists who thought their patients prefer fluoride varnish use it more than other topical fluorides.

Conclusion: The majority of dentists are not aware of the advantages of fluoride varnish. However, those who are, choose to use it as opposed to foams and gels. Recent graduates, with more exposure to fluoride varnish, use it more frequently.

Introduction

Topical fluoride application has been the standard of care in American dental offices for many years, especially in the pediatric population. Dentists apply fluoride products for the primary prevention of dental caries and to prevent early carious lesions from progressing.¹ Several forms of topical fluoride exist including foams, gels, dentifrices, rinses, and varnish.² The clinical recommendations for the use of professionally applied topical fluoride by the American Dental Association are broken down into age categories. For children under 6 years of age with low risk, topical fluoride may not be beneficial. For children under 6 years of age with moderate risk, fluoride varnish applications should be received at 6 month intervals and higher risk patients should receive fluoride varnish at 3 to 6 month intervals. Patients 6-18 years of age have the same recommendations as the under 6 year old patients with one exception; the moderate and high risk patients may receive fluoride varnish or gel applications. Fluoride gels are not recommended by the ADA for children under 6 years of age due to the risk of inadvertent ingestion.¹

Fluoride varnish has been widely used for over 25 years in Scandinavia and Europe, however, it was only recently introduced in the United States.³ It was approved by the US Food and Drug Administration (FDA) in 1994 for the treatment of dentin hypersensitivity associated with the exposure of root surfaces or as a cavity varnish,

however, it has not been approved yet for caries prevention.^{1,4} Therefore, using it for caries prevention is currently considered “off-label” since it has not been cleared by the FDA for this purpose.⁵ In spite of this, there exists a vast amount of published data verifying its effectiveness, consequently, there is not a legal risk in using it off label.^{3,6,7,8}

Acidulated phosphate fluoride (APF) gels are the most commonly used topical fluoride in the US, but when compared to fluoride varnish the APF gels have several disadvantages; primarily the bitter taste and risk of over ingestion. Many factors can cause over ingestion including inadequate suction, improper placement of the tray, a surplus of gel, or inability of the patient to expectorate the remaining gel.³ If the patient swallows the gel dose they do so in a short amount of time and this will cause a significant increase in the plasma fluoride concentrations.⁹ On the contrary, fluoride ingestion following a varnish treatment has barely detectable effects on plasma fluoride concentrations due to the much smaller dose swallowed over several hours.¹⁰ The varnish adheres to the enamel for an extended period of time preventing systemic consumption of fluoride in large doses. The advantage of APF foam is that less fluoride is applied to the tray, thus decreasing the amount of fluoride that is swallowed. A study by Whitford and colleagues concluded that APF foam and gel are equivalent with respect to fluoride uptake and that only one-fifth the amount of foam is required to sufficiently cover the teeth.¹¹ The two most commonly used gels include APF, which contains 1.23% or 12,300 parts per million fluoride ion and 2% sodium fluoride (NaF) which contains 0.90% or 9,050 ppm fluoride ion. Varnishes typically contain 5% sodium fluoride which equals 2.26% or 22,600 parts per million fluoride ion.¹ The concentration of fluoride in varnish is almost double that of APF gel,

however, as Bawden pointed out, “the amount of fluoride in the mouth of a child as a result of a varnish application is less than 7 mg compared with 30 mg or more with an APF application.”³ The amount of fluoride retained in the oral cavity after treatment with a 1.23% APF foam was reported to be approximately one-half that retained with a gel;¹² however, the in vitro fluoride uptake was not significantly different.¹¹

The American Dental Association produced evidence-based clinical recommendations on professionally applied topical fluoride which found that fluoride varnish applied every six months is effective in preventing caries in the primary and permanent dentition of children and adolescents.¹ It has also been concluded that two or more applications of fluoride varnish per year are effective in preventing caries in high risk populations¹ and decreasing caries in primary teeth.^{13,14} Repeated applications of varnish at more frequent intervals have been shown to result in greater caries reduction.¹⁵ Weintraub et al found in their two-year randomized clinical trial that fluoride varnish can be used to prevent early childhood caries and reduce caries increment in very young children.⁸ Some of the children in this study were younger than 1 year of age (the American Academy of Pediatric Dentistry’s recommended age for the first dental visit) and yet, they had very little difficulty with cooperation of the infants with fluoride varnish. They also concluded that although frequent applications of varnish were more beneficial, one application was better than none for preventing caries.⁸ Fluoride varnishes have been shown to inhibit demineralization^{16,17,18} and to promote remineralization of enamel.¹⁹

Recently, there has been an increase in the awareness of fluoride varnish due to rapidly expanding number of primary prevention fluoride varnish programs aimed at

reducing levels of Early Childhood Caries (ECC) by targeting dentists, physicians, nurses, and Early Head Start programs. Early Childhood Caries is a significant problem in low-income and minority groups. The young children from these high-risk groups are more likely to seek medical care than dental care.²⁰ To take advantage of this fact, programs like the *Smiles for Ohio Fluoride Varnish Program* were created. These programs reimburse primary care providers for assessing oral health and applying fluoride to the teeth of eligible children.²⁰

Fluoride varnish is safe, fast, and easy to apply, thus being a superior choice for use with young children.²¹ Studies have shown children gag less with fluoride varnish and the cost per varnish application are significantly less when you factor in labor costs.²² Despite the large amount of information supporting the use of fluoride varnish to control caries, many general and pediatric dentists do not use them, instead favoring gels and foams.²³ Fiset et al found general dentists in Washington State cited, “lack of awareness, lack of convincing evidence of a favorable cost:benefit ratio, patients’ rejection of the service, and low caries risk among adult patients” as reasons for not using fluoride varnish.²³ The purpose of this study was to assess the use of fluoride varnish by dental practitioners as well as to determine if there were any differences in varnish use between provider type or the practice’s patient profile.

Materials and Methods

This study was a cross-sectional survey of member dentists of a state dental association. The survey was administered on-line and distributed via a list-serve of subscribed member dentists (n=1528) of the Virginia Dental Association. The survey consisted of a 13-item survey regarding fluoride varnish. The survey was sent using the Inquisite 7.0 web survey software.²⁴ The dentists were asked to complete the survey within 60 days. After the 60 days expired, a reminder email was sent. Dentists were given another 30 days to complete the survey. After the total of 90 days expired, the survey was closed on-line.

The first four questions of the survey were used to gather demographic information about the respondents and also to determine particular practice characteristics to create a practice profile. The survey asked the specialty (if applicable) of the dental practitioner and what percentage of the practices' patient population is made up of children. In addition, the percentage of private insurance, public assistance, and self-pay patients that the respondents treat in their practice was documented.

Questions 5-7 asked respondents about their use of fluoride in different age groups (0-3, 4-6, 6-12, 12-18, 18+) and how often they apply fluoride. The survey then asked what type of fluoride was used: foam, gel, varnish, other, or none was also noted. If the

respondent answered “none” they were thanked for their responses and excluded from the survey.

Questions 8-12 tested the respondents’ knowledge of fluoride varnish and how it compares to the other topical fluorides. They were asked about price, effectiveness, efficiency, systemic exposure, and patient preference. Question 13 asked the respondent to insert their email address and comments if they were interested in further research and continuing education.

Analysis

Univariate distributions were obtained for each question. Percents for all items were based on the total number of respondents. The percentages regarding each questionnaire item were analyzed and comparisons made using a chi-squared test. The association between dental practitioner type, practice profile, and fluoride use was tested using chi-square or Fisher’s exact test. The use of fluoride varnish across different age groups was modeled using logistic regression (SAS PROC GENMOD).

Results

Of the 1528 dentists surveyed, a total of 243 surveys were completed yielding a gross response rate of 16%. Of these 243 respondents, 14 filled out the survey twice and one survey was blank. After excluding the duplicate surveys and the blank survey, 228 surveys were analyzed yielding a final response rate of 15%. The distribution of providers were as follows; general dentists at 78.8% (N=178), pediatric dentists 11.5% (N=26), and other respondents were made up of dental specialists including periodontists (N=10), orthodontists (N=6), oral and maxillofacial surgeons (N=5), and an endodontist (N=1). The majority of the respondents (76%) graduated from dental school from 1970-1999 and the average age of respondents was 49 years old. The survey respondents are described in Table 1.

The respondents were asked in the survey to approximate the percentage of their practice population within the following three age groups: 0 to 6 years of age, between 6 and 18 years of age, and older than 18 years of age. The responses ranged from zero to over 75% in each of these three categories. The largest group of practitioners (81.3%) had 50% or more in the 18 years or older range. Of the remaining 18.7% of practices, 16% has more than 20% of their practice devoted to children under the age of 6. The patient populations are described in Table 2.

Topical fluoride use was first assessed by asking “what type of topical fluoride do you mainly use?” and these responses are shown in Table 3. It was noted that $n = 14$ practitioners did not apply topical fluoride and so these were not included in subsequent analyses. Of the remaining $N=211$ who use topical fluoride, foam was the most popular (37%), followed by varnish (28%), then gel (27%), and finally other topical fluorides (8%).

The objective of this study was to determine what characteristics of dental providers are associated with the use of topical varnish (yes/no). First, the provider characteristics were screened to determine which had a potential relationship. Simple two-way contingency tables are shown in Table 4. The area of dental practice was collapsed into three categories and showed no relationship with the use of fluoride varnish ($p > 0.2$), although there was a trend of more varnish use in pediatric dentists. The year of graduation from dental school was collapsed into decades and indicated a relationship ($p < 0.04$); with more recent graduates indicating fluoride varnish is their preferred topical fluoride. When considered as a continuous variable, year of graduation also indicated a possible relationship (LR chi-square = 3.88, $p = 0.0488$). Age was potentially related to varnish use when considered as a continuous variable (LR chi-square = 2.54, $p = 0.1110$), but when broken down into decades (Table 4), there was no longer an indication of a relationship ($p > 0.6$). Of course, age and year of graduation are strongly correlated ($r = -0.93$), and so we chose to use year of graduation as a predictor of varnish use. Practices with more than a third of their patient pool under 18 years of age, did not appear to use varnish more than practitioners with less children in their practice ($p > 0.4$). The same was

found for practices with more than 10% of their patient pool less than 6 years of age, though this was closer to being significant ($p < 0.12$).

The variables in Table 4 that pass a bivariate screening for inclusion in a multivariate regression model ($p < .1$) were the year of the practitioner's graduation and the percentage of youth in the practice who are less than 6 years of age to be at least 10%. When considered in a logistic regression model, the percentage of youth was still not statistically significant (LR chi-square = 2.9, p -value = 0.0881) but year of graduation remained significant (LR chi-square = 4.28, p -value = 0.0385). The relationship with graduation year is shown in Figure 1.

The next analyses centered on the relationship between the practitioners' perceptions of fluoride varnish as opposed to other topical fluorides (questions 8-12, see Table 3). The unadjusted relationship between each of the perception questions and varnish use is shown in Table 5. There does not seem to be a relationship with price ($p > 0.3$), but there is a relationship with effectiveness, time, systemic exposure, and patient preference ($ps < 0.0002$). When these four perception variables are used in a logistic regression model that also includes graduation year, year of graduation is no longer significant ($p > 0.4$) and neither is the perception of systemic exposure ($p > 0.5$). Thus, the final model which predicts the use of fluoride varnish includes the following three terms: effectiveness, length of application time, and patient preference.

The significant terms from the final regression model were used to create a perception score to predict the use of fluoride varnish. The three factors were combined by adding up +1, 0, and -1 scores for each. Specifically, the effectiveness question may be

scored as +1=more effective or -1=other. The time consuming question may be scored as +1=less time consuming, 0=equal, -1=more time consuming. Finally, the patient preference question may be scored as +1=prefer varnish and -1=other preference. The sum of these three may thus range from -3, a negative on all three perception variables, to +3, a positive preference. The relationship between this perception score and the percentage of varnish use is shown in Table 6 and Figure 2. As may be seen, those respondents with a +3 perception score choose varnish 80% of the time while those with a +2 perception score choose varnish 71% of the time. A +1 perception score indicates 46% varnish use, a score of 0 indicates 15% varnish use, and a -1 score designates 9% varnish use. Any score less than -1 did not use fluoride varnish at all.

Discussion

Studies have shown that a minority of dentists use fluoride varnish on a regular basis for caries prevention and control.²³ The various reasons for the low utilization rates of varnish may be due to a lack of awareness, lack of FDA approval, and lack of evidence for a favorable cost:benefit ratio. In this study, the majority of respondents thought that fluoride varnish was more time consuming (43%) and had equal systemic exposure (46%) when compared to foams and gels. In reality, varnish is less time consuming; taking only a minute per application as opposed to the 4 minute application time recommended for gels and foams.¹ Also, varnish has been proven to have less systemic exposure and barely detectable effects on plasma fluoride concentrations due to the much smaller dose swallowed over several hours.¹⁰ The greater part of respondents (44%) also claimed to not know how fluoride varnish compared to other topical fluorides in price. However, those dentists who were aware of the advantages of varnish were more likely to use it as opposed to foams and gels. The respondents who correctly viewed varnish as more effective and less time consuming were more likely to use it on their patients. Naturally, those who perceived patients to prefer varnish were also more likely to use it in their practice.

This study found a positive correlation between the year of graduation from dental school and fluoride varnish use (Figure 1). Not surprisingly, those who have had more exposure to fluoride varnish, use it more frequently. Fiset et al confirmed this theory by

proving that dentists who knew more about fluoride varnish were more likely to implement the technology than those who knew less.²⁵ Fluoride varnish was not available in the United States until the early 1990s; thus, anyone who graduated before its availability was unable to become accustomed to using it during dental school. By contrast, every dental student who graduates from Virginia Commonwealth University School of Dentistry, uses varnish on a daily basis during their rotations in the pediatric dental clinic. Dixon et al demonstrated that diffusion of new technology in the medical profession functions through observation of colleagues and a clinician's own experience in using the new technology.^{25,26}

This study had some limitations in respect to the survey sample and on-line administration. First, it relied on email addresses that were given by the dentists to the Virginia Dental Association (VDA) to be used for their list-serve. Many email accounts have "junk mail" folders that filter email from unidentified senders. Thus, the survey could have been unknowingly discarded by potential respondents if they were blocking VDA-list serve email. Also, many dentists chose not to list their email with the VDA and therefore were automatically prevented from receiving the survey. Unfortunately, not all dentists in the state of Virginia are members of the VDA and therefore those dentists did not receive the survey. Second, the list-serve is not divided by dental specialties. Thus, specialists that rarely use fluoride, such as endodontists and oral surgeons, were included in the survey and consequently the results. This survey also had a modest response rate from dentists compared to recent paper surveys that have been done on this same

population.²⁷ It is probable that the response rate would have increased if a paper survey had been sent in addition to the electronic version.

In conclusion, the majority of dentists are not aware of the advantages of fluoride varnish. However, those who are, choose to use it as opposed to foams and gels. Dentists who have recently graduated from dental school are more likely to use fluoride varnish. Also, dentists who thought fluoride varnish was more effective and less time consuming use it more than other topical fluorides and those who thought their patients prefer fluoride varnish use it more than other topical fluorides. This survey supports the fact that more educational opportunities, both didactic and clinical, should be offered to dentists to familiarize them with the clinical superiority, technique, and advantages of fluoride varnish.

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Literature Cited

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Table 1: Description of Those Surveyed (N=228)

Characteristic	N	Percent
Area of dental practice		
Endodontics	1	0.4
General Dentistry	178	78.8
Oral and Maxillofacial Surgery	5	2.2
Orthodontics	6	2.7
Pediatric Dentistry	26	11.5
Periodontics	10	4.4
Year of graduation from dental school		
prior to 1969	14	6.1
1970s	62	27.2
1980s	66	28.9
1990s	45	19.7
2000s	40	17.5
Age (years)		
Mean	49.2	
SD	11.2	
youngest	24	
oldest	75	

Table 2: Description of Practice Characteristics

Characteristic	N	Mean	SD	Range
Percentage of patient population in age groups:				
< 6 years	226	11.8	16.6	0 75
6-18 years	226	22.0	17.0	0 90
18+ years	226	66.2	28.4	0 100
N Percent				
Youth (under 18) patient population 33% or more				
N	153	68.0		
Y	73	32.4		
Children (under 6) patient population 10% or more				
N	130	57.8		
Y	96	42.7		

Table 3: Application of Topical Fluoride

Usage	N	Percent
5. What type of topical fluoride do you mainly use?		
Foam	77	34.2
Gel	57	25.3
Varnish	60	26.7
Other	17	7.6
None	14	6.2
6. In what age categories of patients are you applying topical fluoride?		
0-3 Years	77	36.2 *
4-6 Years	177	83.1 *
7-12 Years	200	93.9 *
13-18 Years	184	86.4 *
19+ Years	105	49.3 *
7. In a typical patient, how often do you apply fluoride?		
According to patient's risk/history of decay	46	21.6
Once a year	25	11.7
Twice a year	142	66.7
8. How do you think fluoride varnish compares in price to other topical fluorides?		
Cheaper	4	1.9
Same	29	13.6
More Expensive	86	40.4
Don't Know	94	44.1
9. Do you think fluoride varnish is _____ effective than gels and foams?		
More	138	66.0
Equal	60	28.7
Less	11	5.3
10. Do you think fluoride varnish is _____ time consuming than gels and foams?		
More	89	42.8
Equal	65	31.3
Less	54	26.0
11. Do you think fluoride varnish has _____ systemic exposure than gels and foams?		
More	37	17.7
Equal	95	45.5
Less	77	36.8
12. Which product do you think patients would prefer?		
Foam	63	30.0
Gel	45	21.4
Varnish	84	40.0
Other	18	8.6

Table 4: Unadjusted Relationships with Topical Fluoride Varnish Use

Characteristic	Varnish use?		
	N	Y	% Yes
Area of dental practice			
General Dentistry	127	45	26.2
other	10	4	28.6
Pediatric Dentistry	14	11	44.0
LR chi-square = 3.2, p-value = 0.2038			
Year of graduation from dental school			
prior to 1969	8	4	33.3
1970s	46	8	14.8
1980s	42	20	32.3
1990s	33	11	25.0
2000s	22	17	43.6
LR chi-square = 10.5, p-value = 0.033			
Continuous trend, LR chi-square = 3.88, p-value = 0.0488			
Age (years)			
20s	4	3	42.9
30s	28	16	36.4
40s	37	13	26.0
50s	53	17	24.3
60s and older	29	11	27.5
LR chi-square = 2.7, p-value = 0.6035			
Continuous trend, LR chi-square = 2.54, p-value = 0.1110			
Youth (under 18) patient population 33% or more			
N	107	38	26.3
Y	44	21	34.2
Fisher's exact p-value = 0.4074			
Continuous trend, LR chi-square = 3.53, p-value = 0.0604			
Children (under 6) patient population 10% or more			
N	90	28	23.7
Y	61	31	33.7
Fisher's exact p-value = 0.1235			
Continuous trend, LR chi-square = 6.21, p-value = 0.0127			

Table 5: Unadjusted Relationships with Fluoride Varnish Use

Perception	Varnish use?		% Yes
	N	Y	
8. How do you think fluoride varnish compares in price to other topical fluorides?			
Cheaper	3	1	25.0
Same	19	9	32.1
More Expensive	56	29	34.1
Don't Know	73	21	22.3
LR chi-square = 3.3, p-value = 0.3462			
9. Do you think fluoride varnish is _____ effective than gels and foams?			
More	81	55	40.4
Equal	56	4	6.7
Less	10	1	9.1
LR chi-square = 25.3, p-value = <.0001			
10. Do you think fluoride varnish is _____ time consuming than gels and foams?			
More	78	11	12.4
Equal	47	17	26.6
Less	22	31	58.5
LR chi-square = 34.1, p-value = <.0001			
11. Do you think fluoride varnish has _____ systemic exposure than gels and foams?			
More	32	4	11.1
Equal	73	22	23.2
Less	42	34	44.7
LR chi-square = 16.8, p-value = 0.0002			
12. Which product do you think patients would prefer?			
Foam	58	5	7.9
Gel	40	5	11.1
Other	16	2	11.1
Varnish	34	48	58.5
LR chi-square = 59.8, p-value = <.0001			

Table 6: Perception Score and Varnish Use

Score	Varnish use?		Total	%
	N	Y		Yes
-3	30	0	30	0
-2	11	0	11	0
-1	48	5	53	9
0	28	5	33	15
+1	15	13	28	46
+2	5	12	17	71
+3	6	24	30	80
Total	143	59	202	29

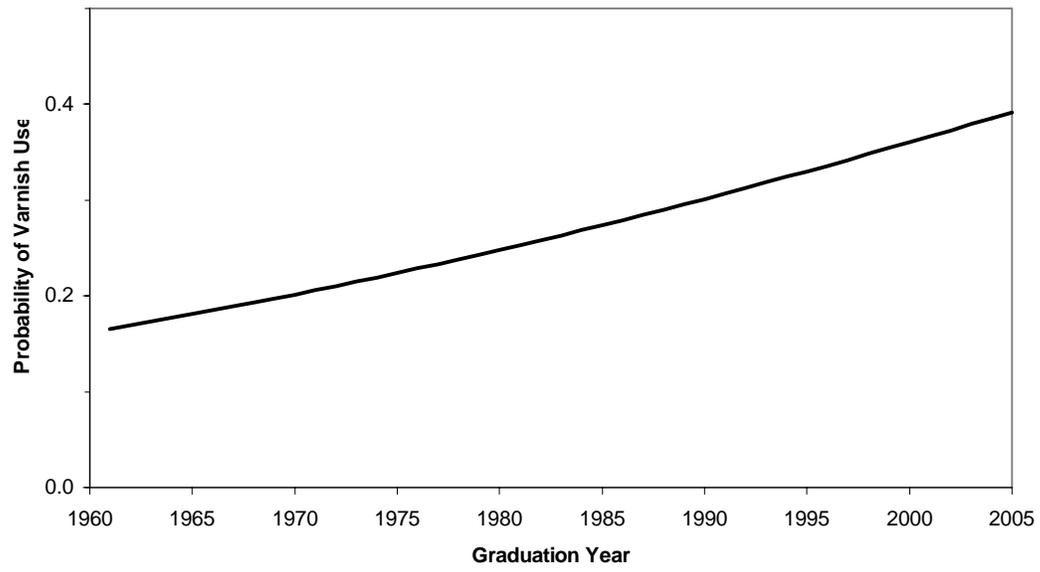


Figure 1: Relationship with Graduation Year

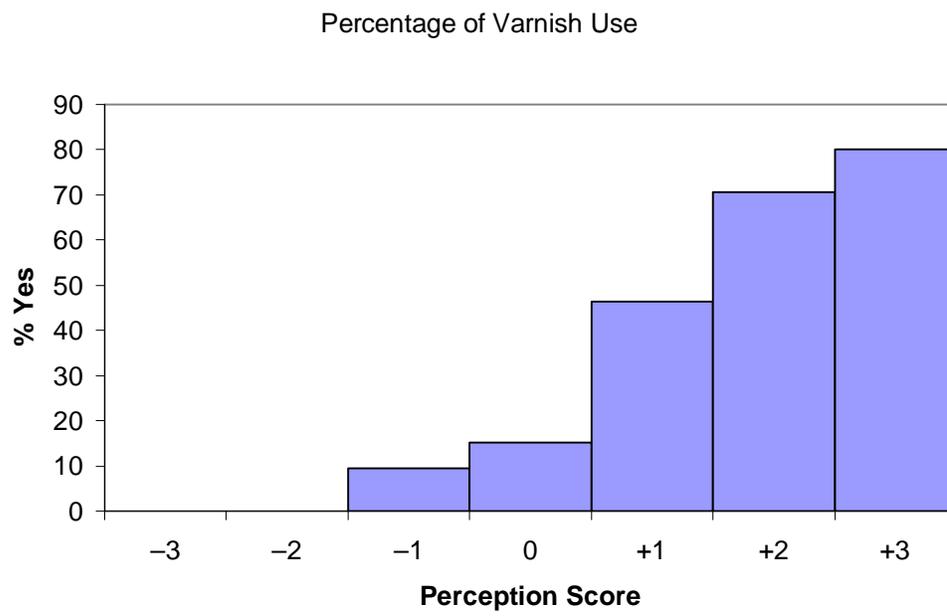


Figure 2: Perception Score and Percentage of Varnish Use

APPENDIX A

Survey

1) What is your area of Dental Practice?

- General Dentistry
- Pediatric Dentistry
- Orthodontics
- Periodontics
- Endodontics
- Oral and Maxillofacial Surgery
- Other _____

2) What is your age?

3) What year did you graduate from dental school?

4) Please describe the characteristics of your patient population

Age	< 6 years	6-18 years	18+ years
Approximate Percent (%)			
Dental Coverage	Private Insurance	Public Assistance	Self-Pay
Approximate Percent (%)			

5) What type of topical fluoride do you use?

- Foam
- Gel
- Varnish
- Other _____
- None (This survey focuses on the use of topical fluorides, Thank you for your responses)

6) In what age categories of patients are you applying topical fluoride?

- 0-3 Years
- 4-6 Years
- 6-12 Years
- 12-18 Years
- 18+ Years

7) How often do you apply fluoride?

- Once a year
- Twice a year
- According to patient's risk/history of decay

8) How do you think fluoride varnish compares in price to other topical fluorides?

- Cheaper
- Same
- More Expensive
- Don't Know

9) Do you think fluoride varnish is _____ effective than gels and foams?

- More
- Equal
- Less

10) Do you think fluoride varnish is _____ time consuming than gels and foams?

- More
- Equal
- Less

11) Do you think fluoride varnish has _____ systemic exposure than gels and foams?

- More
- Equal
- Less

12) Which product do you think patients would prefer?

- Foam
- Gel
- Varnish
- Other

13) If you are interested in participating in further research and continuing education related to fluoride varnish please enter your email address here.

VITA

Amanda Bowen Kuhn was born on November 27, 1979 in Indianapolis, Indiana. She graduated from James B. Hunt High School, Wilson, North Carolina in 1998. She received a BS in Biology from The University of North Carolina at Chapel Hill, Chapel Hill, North Carolina in 2002. Dr. Kuhn received her Doctor of Dental Medicine from The University of Pittsburgh School of Dental Medicine, Pittsburgh, Pennsylvania in 2006.