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The Use of Silver Diamine Fluoride in Dentistry in Virginia

Jessica Eisenberg

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

By

Jessica Eisenberg, DDS

Stevenson University, 2017

Virginia Commonwealth University, 2021

Thesis advisor: Carol Caudill, DDS

Department of Pediatric Dentistry

Virginia Commonwealth University

Richmond, Virginia

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Abstract

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Pediatric Dentistry

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Purpose: The purpose of this research was to determine the use of silver diamine fluoride (SDF) in dentistry in Virginia and the factors that affect the practitioners' decision.

Methods: A survey was sent to the members of the Virginia Dental Association (VDA) by email and posted on the VDA social media accounts. The survey questions measured the practitioner's demographics, knowledge, and factors that affect their utilization of SDF.

Results: Most providers were general dentists (77%). The most common clinical situations for SDF use were to arrest caries in children with behavioral issues (77%), to delay restorative treatment (73%), in medically fragile patients (67%), for root caries (60%), and for patients with severe dental anxiety (54%). Self-reported use of SDF was significantly associated with the provider's years in practice (P=.0053) and if they felt they have received adequate training (P <.0001). Eighty-nine percent of providers with 5 or less years of experience reported using SDF compared to 60% of those with greater than 5 years of experience.

Conclusion: The practitioners who utilize SDF have more knowledge on SDF. Pediatric dentists reported they have more knowledge, adequate training, and increased use of SDF compared to general dentists. General dentists not using SDF report less knowledge or familiarity with SDF. Adequate training related to the use of SDF and an appropriate reimbursement level is important to increase SDF use among dentists in the future.

Introduction

Silver diamine fluoride (SDF) is a caries arresting and desensitizing liquid medicament utilized in the dental field with a pH of 10.[1] One of the uses of SDF is as a minimally invasive technique to attempt to arrest carious lesions. SDF may be recommended as a treatment option for patients when traditional dental restorations are not possible due to behavior, when there are financial concerns, where there is a problem with access to dental care, or to avoid general anesthesia.[2] Since the 1970's, SDF has been available for use in Japan.[3] While SDF has been approved by the Food and Drug Administration (FDA) in the United States since 2014 for reduction of dentin sensitivity, it is also used off-label to arrest caries.[4,5] In 2016, silver diamine fluoride received a working Current Dental Terminology (CDT) code, D1354.[6]

The detailed mechanism of action of SDF is not currently completely understood; however, it is believed that the SDF is beneficial in caries arrest and prevention in several ways. First, in a basic environment, SDF forms calcium fluoride which then forms fluorapatite. Fluorapatite is less prone to demineralization compared to hydroxyapatite in an acidic environment.[7] Second, fluoride ions are released into the oral cavity due to the property that calcium fluoride dissolves into the saliva, which helps remineralize the tooth structure.[4,5] In addition, an insoluble silver chloride forms "which acts as a protective layer and inhibits further

demineralization by limiting the loss of calcium and phosphate ions."[4] Finally, studies suggest the silver in SDF has antibacterial properties.[5]

The use of SDF to arrest caries in primary teeth is conditionally recommended by the American Academy of Pediatric Dentistry due to clinical trials having a high risk of bias; however, certain studies showed a caries arrest rate greater than 80 percent.[8] The efficacy of SDF is dependent on the location of caries. In 2019, an article on Evidence Based Dentistry Update on SDF indicated that anterior teeth have a higher rate of caries arrest compared to posterior teeth.[5]

There are advantages and disadvantages of SDF, and it is important that informed consent is obtained in order for the patient or their guardian to be aware of the possible outcomes. One advantage of SDF is that it is a minimally invasive treatment to arrest caries, and it is a relatively quick treatment.[4,9] Another benefit of SDF is that it can be applied without producing aerosols, an important consideration in the time of an airborne pandemic.[10] A final advantage of SDF is that it can be used to delay the need for definitive dental treatment with sedation and general anesthesia until the patient may be more cooperative and more safely treated with moderate to deep sedation.[11] On the other hand, the main disadvantage of silver diamine fluoride is permanent staining of the carious tooth structure, staining of clothes, as well as temporary staining of soft tissue.[7] Staining of skin is temporary and the duration is until the skin cells (keratinocytes) are shed in 14 days.[12] Another disadvantage of SDF is the taste which is metallic and may upset a pediatric patient.[3] SDF should be avoided in people with a silver allergy.[12] A reapplication may be indicated to arrest the caries, and there is no guarantee that it will arrest the caries.[2,12] Informed consent including the advantages and disadvantages of SDF should be obtained prior to the utilization.[7]

Pediatric Dentist outlook on SDF/ Knowledge and attitudes of practitioners in the United States

Several studies have shown that the more information that a pediatric dentist reports knowing about SDF, the more that they report utilizing it. A 2019 study evaluated pediatric dentists' education, knowledge, attitudes, and professional behavior on silver diamine fluoride in the United States.[2] The researchers found that pediatric dentists reported that SDF was a reasonable treatment option for children with behavioral issues (85%), for medically fragile patients (85%), and for patients with dental anxiety (81%).[2] They found that the pediatric dentists who reported receiving more education on SDF were more likely to utilize SDF in clinical practice. 98% of respondents indicated that they never used SDF while in dental school, and 91% of respondents never used it in residency.[2] Most of their education on SDF was through continuing education courses and online resources. However, the researchers argued that more research needs to be conducted on this topic among general dentists.[2] A thesis utilized the Theory of Planned Behavior (TPB) on SDF to anticipate the behavior of dentists in the specialty of pediatrics, endodontics, oral surgery, orthodontics, and periodontics practicing in Wisconsin on SDF. The authors found a positive correlation between SDF and a higher TPB number that "measured attitudes, perceived behavior control, and subjective norms regarding SDF."[9] Among the participants who did not use SDF, 73% agreed that they would need more training, while only 16% of the participants who used SDF thought they needed more training. On the other hand, 74% of the participants who utilized SDF disagreed that they would need more training. A majority of pediatric dentists utilized SDF (11 of the 13 pediatric dentists).[9] Almost half of the dentists who practiced in a general practice setting utilized SDF (30 of the 61 dentists).[9] A 2020 qualitative study from North Carolina interviewed pediatric dentists and general dentists about methods of minimally invasive dentistry from an office that primarily sees children. The researchers found that dentists considered SDF to be a beneficial treatment option to either delay

or avoid general anesthesia or sedation. SDF was one of the commonly used non-surgical caries management techniques reported in this study compared to options like atraumatic restorative treatment or Hall technique crowns.[13]

International Dentists' Utilization and Knowledge of SDF

Similar to the studies of pediatric dentists in the US, international dentists from the United Kingdom, Pakistan, Saudi Arabia, India, Netherlands, and Japan also indicated the need for more education prior to utilization of SDF. In 2020, Seifo et al. found that the amount of information and understanding of SDF from dental professionals were on different the United Kingdom. Some dental professionals had not heard of SDF prior to the interview and others had previously used SDF in practice.[14] A nationwide survey conducted in Pakistan found that 79.8% of the participants' knowledge on SDF came from online resources and 46.1% of the participants' knowledge came from a dental journal. Even though the participants had some knowledge, there was a need for more education on SDF.[15]

In 2020, the dental practitioners who worked in Riyadh, Saudi Arabia were surveyed about their knowledge and usage of SDF. More than half of the participants (60%) had not applied SDF. Specialties in pediatric dentistry, advanced education general dentistry, and then general dentistry had the most knowledge of SDF. No difference was noted between the participants' characteristics including gender, age, and their knowledge of SDF.[16] On the other hand, a study conducted in the western region of Saudi Arabia found that the majority of the general dentists (92.45%) knew about SDF and agreed SDF was successful in arresting dental caries (61%). The general dentists in this region had increased knowledge and increased use of SDF compared to other regions of Saudi Arabia.[17]

In 2021, researchers utilized a survey to determine dentists' awareness of SDF in Saudi Arabia. Ezzeldin et al. found that 73.6% of specialists (residents and fellows), 54.9% of graduates (interns and general practitioners of dental surgery), and 39.6% of students in the bachelor program of dental surgery expressed awareness towards SDF. This study showed that the interns and general practitioners of dental surgery have insufficient knowledge of SDF.[18] Similarly, in a cross-sectional survey, researchers surveyed dental students, general dentists, and specialists on their knowledge and attitudes of SDF. Over half (58%) of the participants did not know that SDF was used in dentistry. The main barriers reported by dentists for SDF use were tooth stain (48.5%), scientific knowledge (47.5%), and inadequate training (35.6%). In addition, almost half (45.54%) of the participants did not know the application protocol for SDF. The authors discussed a potential increase in usage in the future with an increase in the providers' education.[19]

A survey conducted in India found that participants reported needing more knowledge on SDF. About 5.6% of the participants in this study felt they had enough education in their dental school degrees at both Bachelors and Masters level. Less than 15 percent (14.4%) self-reported that they had enough knowledge on SDF use in dentistry. The authors concluded that an increase in education of SDF would increase the utilization of SDF.[20] Similarly, a cross-sectional study in India surveyed undergraduate, general dentists, and specialists. Two of the barriers to the use of SDF were lack of proper knowledge and proper training (30% and 27% of respondents respectively). Overall, the researchers emphasized the participants needed more education to potentially lead to an increased use.[21] A recent study from India also demonstrated that one of the main barriers to SDF use was the insufficient knowledge on SDF.[22]

General dentists and pediatric dentists in the Netherlands reported that they felt more comfortable utilizing SDF with an increase in education/knowledge. In a cross-sectional survey, the researchers found that the majority of practitioners (60%) that were not utilizing SDF felt the main barrier was not having enough knowledge of SDF. The barrier for the practitioners that utilized SDF (47%) was the parental acceptance.[23] In the mixed method study in Japan, where SDF has been utilized since the 1970s, the researchers found that all of the dentists who participated in the questionnaire have known about SDF. They concluded that popularity of SDF declined due to the staining of the tooth. It discussed the possible increase of SDF use in the future for root caries due to the rising age of the community in Japan.[3] Overall, international dentists from the United Kingdom, Pakistan, Saudi Arabia, India, Netherlands, and Japan report the need for more education on SDF.

Dentists and Hygienists Utilization and Knowledge of SDF in the United States

In a thesis from The Ohio State University, researchers found that pediatric dentists are most likely to utilize SDF. Researchers concluded that the main perceived disadvantage was esthetics among the surveyed dentists, general dentists, and pediatricians. One of the main barriers that general dentists reported was lack of education (54%), followed by lack of coverage by insurance (46%). The researchers found that the more recent dental school graduates were more willing to utilize SDF with proper training. [24] In another study, registered hygienists were surveyed in California. Fifty-four percent of hygienists reported that they were inexperienced with SDF, 32% did not know about SDF, and 22% were not positive on the clinical indications of SDF.[25] Overall, they demonstrated lack of knowledge with SDF.

A systematic review by Mohammad et al. focused on the knowledge and attitudes of dental students, dental hygienists, dentists, and pediatric dentists in United States, Saudi Arabia,

Brazil, Netherlands, Pakistan, and India. The study found that an increase in education on SDF was associated with more utilization of SDF in practice.[10]Overall, there is a reported lack of knowledge on SDF from the limited studies on dentists and dental hygienists in the United States.

Use of Silver Diamine Fluoride by Reviewing Dental Claims

A recent study aimed to explore the current use of SDF by pediatric dentists and general dentists in the United States.[6] A commercial dental claims warehouse provided data for this cohort study using the code D1354. This study only included private insurance claims, and neither Medicaid nor any other claim types were included. Pediatric dentists treated more children aged 0 to age 18 years compared to general dentists who treated adult patients greater than 18 years of age. Likewise, pediatric dentists treated both anterior and posterior teeth with SDF in children aged 0 to 8 years and more posterior teeth with SDF in children aged 8 to 18 years compared to general dentists. [6] Similarly, a study from 2019 focused on SDF use by expanded practice dental hygienists and subsequent approval by Medicaid found an increase in SDF use in relation to the approval of SDF by Medicaid.[26] Both specialty and insurance reimbursement may play an important role in the use of SDF.

Current education of SDF

A study of pediatric dentists in 2019 found that 53% of participants reported that they were educated on SDF through dental journals and other publications, 41% of participants through use of online resources, 38% with continuing education courses, and 27% through dental organizations. Ninety-eight percent of pediatric dentists did not use SDF in dental school. Greater than 90% of participants reported they were not educated in dental school. There was an

increase in percentage of participants who were educated in residency both in classroom and the clinical setting compared to pre-doctoral training.[2]

Education of SDF ideally begins in dental school. In a survey conducted among dental students from seven different dental schools, the students reported learning about SDF in both didactic and clinical training. However, almost half of the dental students indicated that they have not used SDF in the clinic.[27] Similarly, a study focused on SDF education in dental school found that majority of the dental schools (67.7%) included SDF in their education, with half (50%) of the dental schools' provided education in the form of didactics, while less than half provided both didactic and clinical education on SDF. The majority of the dental schools who provided education on SDF had less than 2 hours of education dedicated to SDF.[28] Dentists have had previous education on SDF, but the education was limited.

Knowledge and attitudes of Parents/ Guardians

Parents/guardians' attitudes of SDF are mostly dependent on the location placement of SDF. Parents/guardians have demonstrated acceptance of staining on posterior teeth compared to anterior teeth. Parents/guardians who had children with dental caries participated in a survey on SDF. Almost 46% of parents/guardians found SDF unacceptable for anterior teeth, while only 21% of parents/guardians found SDF unacceptable for posterior teeth. However, parents/guardians were more willing to accept staining on anterior teeth if this would allow the patient to avoid general anesthesia or sedation.[11] An article that reviewed both parent and practitioner acceptance and satisfaction of SDF found that the staining of the tooth structure with SDF was not associated to the parents/guardians' acceptance and approving of SDF as a treatment for their child; however, providers accepted SDF less due to the unesthetic outcome.[29] In a qualitative study, the researchers interviewed parents/guardians who had children younger

than 3 years of age treated with SDF preferred the staining of SDF to other invasive treatment options. The parents/guardians revealed that their children were not opposed to staining but suggested that may change when they are school age. The parents indicated that they would recommend SDF to others.[30] In general, parents/guardians were accepting of SDF as a treatment option for their child.

Study Purpose

The aim of this research was to determine the use of silver diamine fluoride in dentistry and the factors that affect the practitioners' decision in Virginia.

The hypothesis was that formal training on silver diamine fluoride was a major influence in the utilization of silver diamine fluoride by dentists in their practice. It was also hypothesized that pediatric dentists utilized SDF more than general dentists.

Methods

This study was a cross-sectional survey with approximately 40 questions that were developed by modifying a previous survey by Dr. Marita Inglehart who surveyed pediatric dentists in the United States through the American Academy of Pediatric Dentistry.[2] Certain questions were utilized with permission and other questions were adapted. The questions measured the practitioner's demographics, knowledge of silver diamine fluoride, and factors that

affect their utilization of SDF (Appendix 1). The survey branched to additional questions if the practitioner answered "Yes" to the utilization of SDF; however, if the practitioner answered "No" to the utilization of SDF, the participant was able to answer the questions about their general knowledge of SDF. The last question of the survey included a free response for additional comments or thoughts on SDF. This study was approved as exempt by the Institutional Review Board of Virginia Commonwealth University with the study ID number HM20023939.

Members of the Virginia Dental Association (VDA) were recruited for participation in the survey via email, the VDA Facebook page, and the VDA LinkedIn page. The email was sent to 3,688 VDA members. The VDA Facebook page had 3,444 followers and the VDA LinkedIn account had 564 followers. An explanation of the survey was provided in the email and on the websites. The recipient had the opportunity to either participate or not participate in the survey. Survey responses were collected through REDCap on the VCU server.[31] The responses were not connected to the email address to maintain anonymity and because practitioners who responded to the survey on Facebook or LinkedIn were provided with a public link to the survey.

The first email announcement was sent out on July 7, 2022. A first reminder email was sent on July 9, 2022 to all email addresses who did not open the previous email. The VDA posted the survey to the VDA social media (Facebook, LinkedIn) on July 7, 2022 and again on August 13, 2022. The social media post stated, "Click the link to participate in an important VCU survey on SDF and General Dentistry. Participants can download an information sheet on SDF and an example SDF consent form."

The link to survey in the Virginia Dental Journal (The Digest) was sent out on July 12, 2022 and again on July 26, 2022. Another link to the survey in The Digest was sent on August

23, 2022 with the title, “Closing this week! VCU Dental Provider Survey: Use of Silver Diamine Fluoride in General Dentistry.”

The survey contained demographic questions including years since dental school graduation, sex, VDA component, type of dental practitioner, type of practice, and additional training. The primary outcome in this study was the use of SDF in dentistry in Virginia. The outcomes were measured with a Likert scale from: 0= Previously but no longer 1 = never, 2 = rarely, 3 = sometimes, 4 = often, to 5 = very often, often did/do you use SDF, as well as a scale from: major deterrent, deterrent, neutral, benefit, and major benefit. Survey questions included what possible influences on the dentists’ use of SDF including education on SDF, esthetics, cost, and guardian/patient attitudes.

The inclusion criteria were that the participant was a member of the Virginia Dental Association. Participants were excluded from the study if they were not a member of the VDA. The members of the Virginia Dental Association were targeted in this study because it included general dentists as well as specialists in the Virginia area. At the end of the survey, an example of an SDF consent form and a guide to using SDF titled “Chairside Guide: Silver Diamine Fluoride in the Management of Dental Caries Lesions” were available to download.[32]

Responses were summarized using descriptive statistics including counts and percentages for categorical variables and mean, standard deviation for numeric responses. Differences in responses were compared using chi-squared and Fisher’s exact test, as appropriate. The average knowledge rating was compared between users and non-users with t-test. Significance level was set at 0.05. SAS EG v.8.2 (SAS Institute, Cary, NC) was used for all analyses.

Results

A total of 145 providers responded to the survey (3.9% approx. response rate). Most were general dentists (77%) with ten or more years in practice (69%), in a solo or group practice (64%). Nearly all dentists reported treating children in their practice (95%) and 40 percent reported accepting Medicaid insurance. There was a nearly equal distribution of male (51%) and female respondents (45%), and the distribution of providers across the various VDA regions was representative with more respondents in the larger markets (Richmond: 26%, Northern Virginia: 22%, Tidewater: 13%). A complete summary of practitioner demographics is provided in Table 1.

Table 1: Personal and Practice Characteristics of Respondent Providers

	n	%
Years in Practice		
Less than 3 years	18	14%
3-5	7	6%
6-9	14	11%
10 +	86	69%
Gender		
Male	65	51%
Female	57	45%
Other/No response	5	4%
VDA Region		
Tidewater Dental Association	16	13%
Peninsula Dental Society	8	6%
Southside Dental Society	5	4%
Richmond Dental Society	32	26%
Piedmont Dental Society	14	11%

Southwest VA Dental Society	6	5%
Shenandoah Valley Dental Association	13	10%
Northern Virginia Dental Society	27	22%
Unsure	4	3%
Provider Type		
General Dentist	98	77%
Pediatric Dentist	20	16%
Orthodontist	1	1%
Periodontist	1	1%
Endodontist	1	1%
Prosthodontist	1	1%
Oral Surgeon	1	1%
Other	4	3%
Practice Type		
Solo Practice	47	36%
Group Practice	37	28%
Associate Dentist	16	12%
Academic	6	5%
Corporate Dentistry	8	6%
Community Health	8	6%
Hospital Dentistry	8	6%
Other	2	2%
Treat kids		
Yes	118	95%
No	6	5%
Accept Medicaid Insurance		
Yes	49	40%
No	75	60%

Of the responding providers, 66 percent reported currently using SDF in their practice (Table 2). Of those providers who reported using SDF, the most common clinical situations reported were for arresting caries in children with behavioral issues (77%), to delay restorative treatment (73%), in medically fragile patients (67%), for root caries (60%), and for patients with severe dental anxiety (54%). Respondents were also asked about their frequency of use for various clinical situations (Figure 1). Respondents indicated frequency with a 5-point Likert scale ranging from “Never” to “Very Often,” with the addition of “Previously but no longer” as a

choice. More than half (51%) reported using SDF to arrest caries in primary teeth "Often" or "Very Often." The use of SDF to arrest caries in permanent teeth was only rated as "Often" or "Very Often" by 31% of respondents. Arresting caries in patients with special health care needs was rated "Often" or "Very Often" by 41% of SDF users. Respondents were also asked about the influence of characteristics of SDF on Treatment Decisions (Figure 2).

Table 2: Self-Reported Utilization of Silver Diamine Fluoride (SDF)

	n	%
Currently Use SDF		
No	43	34%
Yes	84	66%
Clinical Situations (n=84)		
Arresting dental caries in children with behavioral issues	65	77%
Alternative treatment option to delay restorative treatment	61	73%
When patients are medically fragile	56	67%
For patient with root caries	50	60%
When patients have severe dental anxiety	45	54%
For patients with tooth hypersensitivity	37	44%
When patients are undergoing or have recently undergone radiation therapy or chemotherapy	34	40%
When patients cannot pay for restorations	31	37%
To avoid treatment under general anesthesia	29	35%
When patients take bisphosphonate medications	23	27%
Other	9	11%
Protocol for Application (n=84, Select All that Apply)		
1 application of SDF	27	32%
2 applications of SDF	62	74%
1 application of SDF followed by an interim therapeutic restoration (ITR)/ atraumatic restorative treatment (ART) with materials such as; glass ionomers	23	27%
2 applications of SDF followed by an interim therapeutic restoration (ITR)/ atraumatic restorative treatment (ART) with materials such as; glass ionomers	24	29%
Other	8	10%

Figure 1: Self-Reported Frequency of Silver Diamine Fluoride Use for Various Clinical Scenarios

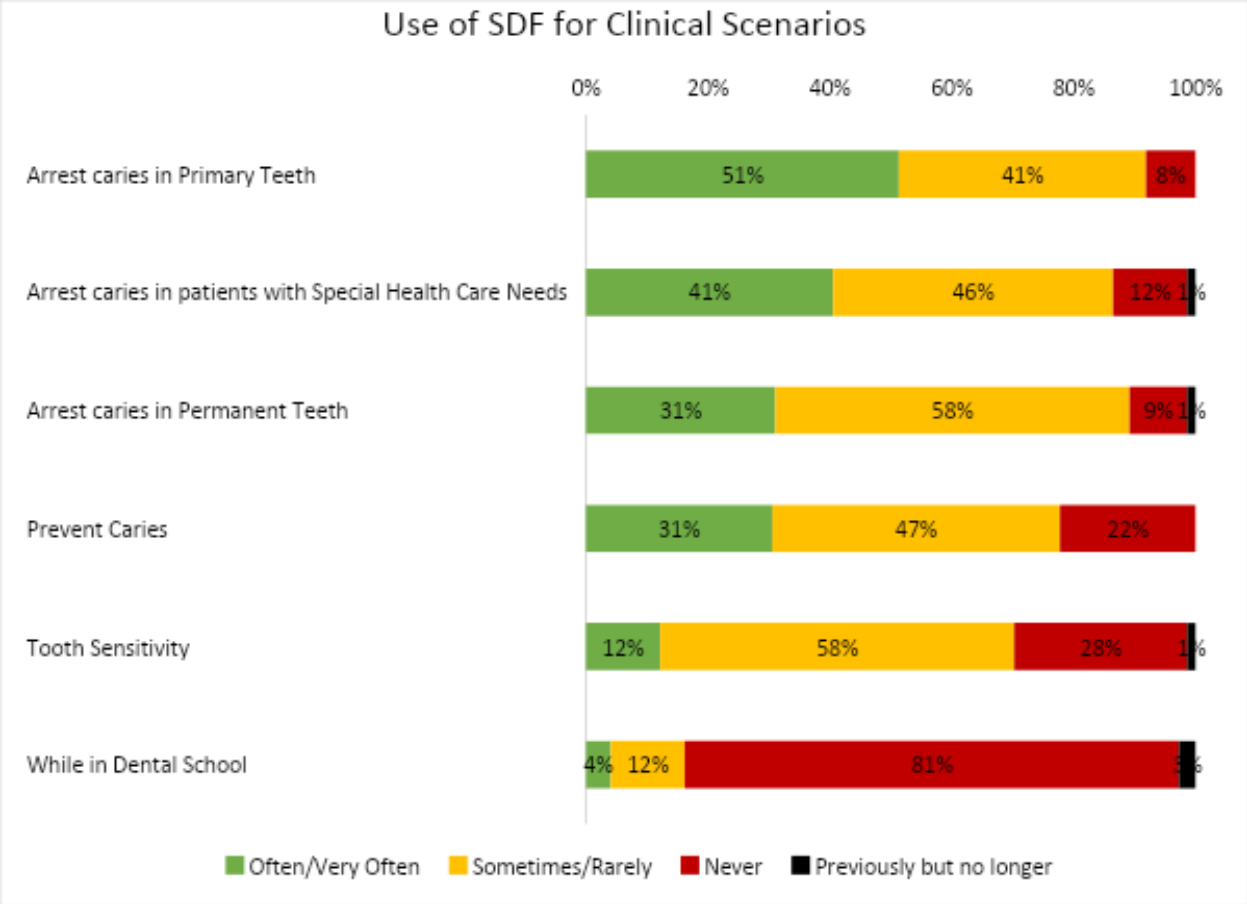
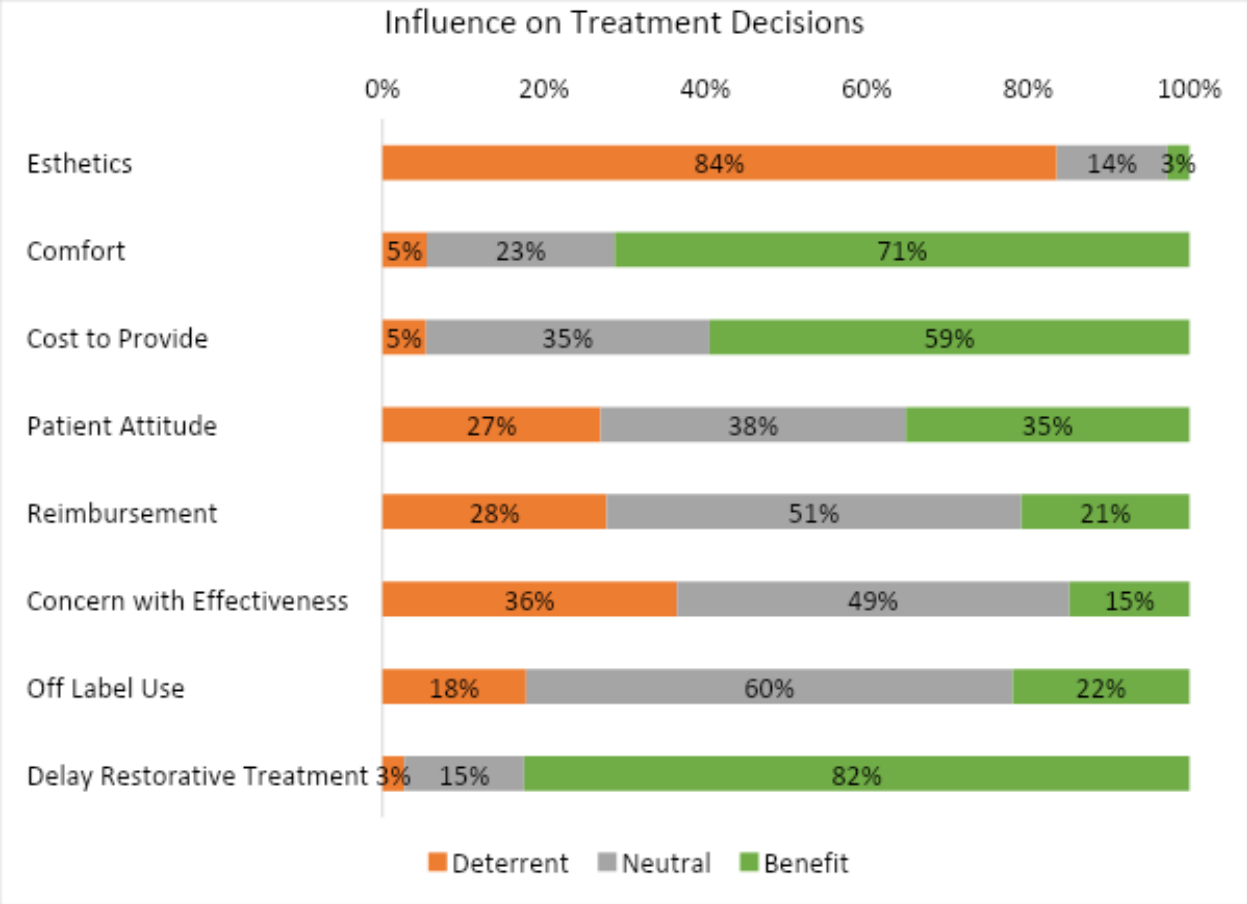


Figure 2: Influence of Characteristics of Silver Diamine Fluoride on Treatment Decisions



Self-reported use of SDF was significantly associated with the provider's years in practice (p-value=0.0053) and if they felt they have received adequate training (p-value<0.0001). Eighty-nine percent of providers with 5 or less years of experience practicing as a dentist reported using SDF compared to 60% of those with greater than 5 years of experience. Those who perceived that they had received adequate training were also more likely to report using SDF than those who did not (86% vs 28%). The other characteristics tested (gender, VDA region, treating pediatric patients, and accepting Medicaid) were not significantly associated with self-reported use of SDF (Table 3).

Table 3: Association of Personal and Practice Characteristics and Self-Reported Use of Silver Diamine Fluoride (SDF)

	Use SDF	**No SDF**	P-value
Years in Practice			0.0053

5 years or less	24 (89%)	3 (11%)	
More than 5 Years	60 (60%)	40 (40%)	
Gender			0.3235
Male	41 (63%)	24 (37%)	
Female	39 (68%)	18 (32%)	
VDA Region			0.8289
Tidewater Dental Association	11 (69%)	5 (31%)	
Peninsula Dental Society	5 (63%)	3 (38%)	
Southside Dental Society	3 (60%)	2 (40%)	
Richmond Dental Society	23 (72%)	9 (28%)	
Piedmont Dental Society	10 (71%)	4 (29%)	
Southwest VA Dental Society	2 (33%)	4 (67%)	
Shenandoah Valley Dental Association	9 (69%)	4 (31%)	
Northern Virginia Dental Society	17 (63%)	10 (37%)	
Unsure	2 (50%)	2 (50%)	
Treat Pediatric Patients			0.9772
Yes	78 (66%)	40 (34%)	
No	4 (67%)	2 (33%)	
Accept Medicaid			0.0744
Yes	37 (76%)	12 (24%)	
No	45 (60%)	30 (40%)	
Perceived Adequate Training			<0.0001
Yes	70 (86%)	11 (14%)	
No	12 (27%)	32 (73%)	

*P-value from Fisher's exact or chi-squared test

Only 65% of respondents felt they had received adequate training on SDF (Table 4). Respondents indicated "self-guided learning" as the most common method of education on SDF (43%). Only 20% reported having a lecture in dental school. Sixteen percent reported they had never received any education on SDF. When asked if more training would make providers feel more comfortable using SDF, 73% responded with a "Yes" or "Somewhat" (44%, 29%, respectively). Twenty-six percent said "No."

Table 4: Self-Reported Training on Silver Diamine Fluoride (SDF)

	n	%
Do you feel like you have adequate training on SDF?		
Yes	81	65%
No	44	35%
Do you feel if you received more training then you would feel more comfortable using SDF?		
Yes	55	44%

Somewhat	36	29%
No	33	26%
Other	1	1%
What was included in your education about SDF?		
Lecture in Dental School	25	20%
In-person lecture in CE course	33	26%
Online dental course (Not including in dental school)	22	18%
Online CE course	44	35%
Hands on application of SDF in dental school)	13	10%
Self-guided learning	54	43%
Never received any education about SDF	20	16%
Other	9	7%

Respondents were asked to rate their knowledge of various aspects of SDF on a scale from "Not at all Familiar" scored as a 1 to "Very Familiar" scored as a 5. The average ratings (Table 5) were greater than 4 ("Moderately Familiar") when asked about general use, use for caries in pediatric patients, and the advantages over traditional dental treatments. Statements regarding using SDF for hypersensitivity, potential problems with SDF, and billing codes had average ratings from 3-3.7 indicating "Somewhat Familiar." Providers who reported using SDF had significantly higher knowledge ratings than those who reported not using SDF (p-value <0.0001 for all statements). The largest difference in average knowledge was regarding potential problems associated with SDF usage which had an average score of 4.2 (95% CI: 4.00-4.45) among users of SDF compared to 2.7 (2.27-3.18) for non-users of SDF for an average difference of 1.5 (95% CI: 1.05-1.71). Free Response comments are provided in Table 6.

Table 5: Self-Reported Knowledge and Familiarity of Various Aspects of Silver Diamine Fluoride (SDF)

	Total Sample	**Use SDF (n=76)**	**No Use (n=40)**	**P-value**
What SDF is used for in dentistry?	4.2 (0.97)	4.5 (0.77)	3.6 (1.03)	<0.0001
How SDF is used for the treatment of tooth hypersensitivity?	3.5 (1.33)	3.9 (1.21)	2.9 (1.29)	<0.0001

How SDF is used to treat dental caries in pediatric patients?	4.2 (1.06)	4.6 (0.70)	3.5 (1.26)	<0.0001
The advantages SDF treatment can have over traditional dental treatments?	4.0 (1.12)	4.4 (0.89)	3.3 (1.19)	<0.0001
The potential problems SDF usage can have?	3.7 (1.35)	4.2 (0.99)	2.7 (1.41)	<0.0001
Which, if any, codes SDF treatments can be billed under?	3.0 (1.55)	3.8 (1.13)	1.4 (0.85)	<0.0001

*Knowledge was rated on a 5-point Likert scale with 5 indicating “Very Familiar” and a 1 indicating “Not at all Familiar”

Table 6: Free Response Comments

Provider Type	Use SDF	Comments
Other	Yes	My typical use of SDF is to avoid anesthesia in patients that do not wish to undergo anesthesia, are medically fragile, or to delay the need for anesthesia until an older age or to allow definitive anesthesia care once, and avoid relapse and repeat anesthetic care.
General Dentist	Yes	Excellent in primary teeth where tooth will be lost soon. Wonderful for caries control in patients with limited cooperation- very young patients, nursing home patients- can be applied with minimal equipment bedside.
General Dentist	Yes	More education/ training on use/ benefits/ and management of permanent teeth which are treated with SDF would be significantly helpful.
General Dentist	No	Have not had much success with SDF in children
General Dentist	No	SDF is so poorly reimbursed that it doesn't cover the chair time in private practice. It does take time to explain it to parents and child, do procedure and set up clean up. Everyone acts likes it's just 3 minutes but no way I can schedule that. Get it reimbursed enough to cover costs of setting up an operatory and paying my staff and is consider it.
Pediatric Dentist	Yes	Great product. We need a higher reimbursement
General Dentist	Yes	Love it! Graduated in 2006 and heard of it, but was not available on the market....so glad to have it as a tool now! I have encouraged many of my colleagues to start using it and since they have begun, there has been no looking back-most parents are very happy with it when you explain risks/benefits/alternative
General Dentist	No	I would love to know more about this and incorporate into my practice
General Dentist	Yes	More education/ training on use/ benefits/ and management of permanent teeth which are treated with SDF would be significantly helpful.
General Dentist	No	I see patients who have also seen the school dentists and SDF has been used with very poor outcome. The children's teeth are very black and they still need their caries treated. I expect the school program is using it as a revenue stream from Medicaid. I have referred one patient to a pediatric office for treatment and he was treated with SDF and at his 6 month recall his large caries was even larger and still needed to be restored. So yes, maybe some education on what circumstances where SDF can be reliably used as 'caries arresting medicament' would be help it be used more ethically.

Those who reported using SDF in their practice were asked on a 5-point Likert scale (-2=Major Deterrent to 2= Major Benefit) whether various aspects of SDF were considered Deterrents or Benefits (Figure 2). Esthetics was considered to be a deterrent to treatment with SDF for 84% of those who use SDF. The most commonly selected benefits were to delay

restorative treatment (82%), patient comfort (71%), and the cost to provide for the patient (59%). Thirty-six percent of practitioners chose "concern with effectiveness" as a deterrent to the use of SDF.

Pediatric dentists were more likely to report using SDF than general dentists (100% vs 61%, p=0.0002) and were more likely to report feeling that they had adequate training on SDF (95% vs 59%, p=0.0015) (Table 7). Clinical scenarios differed as expected based on scope of care, with general dentists more likely to indicate using SDF for root caries than pediatric dentists, and pediatric dentists more likely to indicate avoiding GA treatment than general dentists (Table 7). General dentists also had significantly lower responses to all the self-reported knowledge and familiarity questions (p<0.0001) (*Table 8*).

Table 7: Comparison of SDF Training for Pediatric Dentists and General Dentists

	General Dentists (n=97)	Pediatric Dentists (n=20)	P-value
Currently Use SDF			0.0002
Yes	59, 61%	20, 100%	
No	38, 39%	0, 0%	
Clinical Situations (n=59 for General Dentists; n=20 for Pediatric Dentists)			
Arresting dental caries in children with behavioral issues	47, 80%	16, 80%	>0.999
Alternative treatment option to delay restorative treatment	44, 75%	14, 70%	0.7717
When patients are medically fragile	42, 71%	12, 60%	0.4089
For patient with root caries	42, 71%	5, 25%	0.0005
When patients have severe dental anxiety	31, 53%	14, 70%	0.2008
For patients with tooth hypersensitivity	27, 46%	9, 45%	>0.999
When patients are undergoing or have recently undergone radiation therapy or chemotherapy	27, 46%	6, 30%	0.2959
When patients cannot pay for restorations	22, 37%	8, 40%	>0.999
To avoid treatment under general anesthesia	15, 25%	13, 65%	0.0025
When patients take bisphosphonate medications	17, 29%	4, 20%	0.5641
Other	8, 14%	1, 5%	0.4355
Protocol for Application (n=59 for General Dentists; n=20 for Pediatric Dentists)			
1 application of SDF	19, 32%	6, 30%	>0.999

2 applications of SDF	45, 76%	14, 70%	0.5662
1 application of SDF followed by ITR/ART with glass ionomers	17, 29%	6, 30%	>0.999
2 applications of SDF followed by ITR/ART with glass ionomers	17, 29%	6, 30%	>0.999
Other	5, 8%	2, 10%	>0.999
Do you feel like you have adequate training on SDF?			0.0015
Yes	57, 59%	19, 95%	
No	40, 41%	1, 5%	
Do you feel if you received more training then you would feel more comfortable using SDF?			0.7906
Yes	46, 47%	8, 40%	
Somewhat	28, 29%	6, 30%	
No	23, 24%	6, 30%	
What was included in your education about SDF?			
Lecture in Dental School	18, 19%	5, 25%	0.5406
In-person lecture in CE course	25, 26%	6, 30%	0.7818
Online dental course (Not including in dental school)	18, 19%	3, 15%	>0.999
Online CE course	35, 36%	6, 30%	0.7976
Hands on application of SDF in dental school)	9, 9%	4, 20%	0.2328
Self-guided learning	44, 45%	5, 25%	0.1348
Never received any education about SDF	19, 20%	1, 5%	0.1900
Other	7, 7%	2, 10%	0.6500

*p-value from Fisher's exact test

Table 8: Self-Reported Knowledge and Familiarity of Various Aspects of Silver Diamine Fluoride (SDF) for Pediatric and General Dentists

	General Dentists (n=95)	**Pediatric Dentists (n=20)**	**P-value**
What SDF is used for in dentistry?	4.1 (0.99)	5 (0.00)	<0.0001
How SDF is used for the treatment of tooth hypersensitivity?	3.3 (1.31)	4.8 (0.58)	<0.0001
How SDF is used to treat dental caries in pediatric patients?	4.1 (1.10)	5 (0.00)	<0.0001
The advantages SDF treatment can have over traditional dental treatments?	3.8 (1.13)	4.9 (0.34)	<0.0001
The potential problems SDF usage can have?	3.5 (1.35)	4.9 (0.34)	<0.0001
Which, if any, codes SDF treatments can be billed under?	2.8 (1.47)	4.7 (0.72)	<0.0001

*P-value from unequal variance t-tests

Discussion

Previous research has been conducted on the use and knowledge of SDF with pediatric dentists in the United States as well as general dentists in other countries. There is a gap in the research on SDF use and knowledge with general dentists in the United States.

Fifty-one percent of respondents in this study reported using SDF to arrest caries in primary teeth "Often" or "Very Often," while only 31% of respondents reported using SDF to arrest caries in permanent teeth "Often" or "Very Often." This finding was expected because it is less likely to have a behavior management issue with an adult patient. It was also predictable due to the 84% of respondents answered that esthetics was a deterrent to utilize SDF as a treatment. Due to the deterrent that esthetics has on a treatment option, the providers may choose to utilize SDF more on primary teeth compared to permanent teeth, most likely because primary teeth exfoliate. This finding was similar to multiple studies that showed the staining of the tooth with SDF (the esthetics) was a disadvantage and factor that influenced the use of SDF.[3,7,19,29]

For those who use SDF in their practice, 84% considered esthetics a deterrent to treatment. These participants were not further categorized into general dentists or pediatric dentists. In a study that looked at the parent's concern for esthetics, the parents were more willing to accept the staining from the SDF if the patient could avoid sedation or general anesthesia.[11] Our study was more consistent with the study from 2019 that found providers

accepted SDF less frequently compared to parents due to the non-esthetic outcome.[29] In the 2019 study, it did not specify who was included in the providers.[29] It is important for providers to recognize that parents/guardians may be more accepting of the staining of SDF then they realize, and it is important to inform them of the risks, benefits, and alternatives of all treatment options.

The self-reported frequency of SDF use while in dental school was "never" for 81% of the participants. This may be because 69% of the practitioners reported being in practice for 10 or more years when the use of SDF was not approved.[4] This would have impacted these participants on not receiving this education in dental school. This outcome was similar to a 2019 study from Antonioni et al. which found that over 90% of pediatric dentists had not received education in dental school on SDF which was likely due to most of the practitioners being in dental school before SDF was approved by the FDA.[2]

Self-reported use of SDF was significantly associated with the provider's years in practice (p-value= 0.0053) and if they felt that they had received adequate training (p-value< 0.0001). Around 89% of the providers with five or less years of experience reported using SDF compared to 60% who had greater than five years of experience. There were less respondents (n=27) in the category of five or less years in practice compared to 100 respondents with more than five years in practice, and this association was significant. Due to the recent approval and billing code for SDF, curriculum and training opportunities are quickly evolving.[4] This may have impacted the use of SDF with recent graduates having more training experiences and more comfortable using SDF in practice This was different in comparison to a study from Saudi Arabia that did not find significant difference in the use of SDF by practitioner age; however, this may be because years in practice was more important than age since SDF was not introduced in Saudi Arabia until more recently.[16] A 2019 study that focused on pediatric dentists found older

pediatric dentists received less education on SDF during residency, and older pediatric dentists thought SDF was not a good treatment option for patients.[2] This was different to our study which focused on both general dentists and pediatric dentists, and it did not ask about the participant's age, only the years in practice.

Sixty-five percent of respondents felt they had received adequate training on SDF, while 16% reported they had never received any education on SDF. When asked if more training would make providers feel more comfortable using SDF, 73% responded with a "Yes" or "Somewhat." This is understandable since if they have more training, the practitioners would know the usages and other useful information on SDF. For 26% of participants, more education would not increase their comfort, which could mean the participant already had enough training to make the decision to use or not use SDF. The majority of participants (73%) who did not perceive they had adequate training with SDF did not utilize SDF. This was similar to the 2022 study done in the Netherlands which found that of those 60% of practitioners who were not utilizing SDF indicated that the main barrier was lack of knowledge.[23] These results show that there is a need for further education on SDF.

The most common benefits of SDF were to delay restorative treatment, patient comfort, and the cost to provider for the patient. Thirty-six percent rated "concern with effectiveness" as a deterrent to the use of SDF. Another participant stated, "[I] have not had much success with SDF in children." However, SDF has a known effectivenesss.[8] These findings demonstrate a need for increased education to fill in the gap, which could improve the concern for effectiveness.

In addition, 28% of respondents rated "reimbursement" as a deterrent to the use of SDF. One participant expressed that "SDF is so poorly reimbursed that it doesn't cover the chair time in private practice." They elaborated that while the actual application is not time consuming but

the overall process of the parent/guardian and patient education, set up, clean up takes a longer time. However, the participant explained that if SDF had a reimbursement that could cover costs including staff payment, then the participant would be likely to use SDF. Another participant stated, "Great product. We need a higher reimbursement." The finding of reimbursement as a deterrent was similar to the thesis from The Ohio State University that found one of the main barriers for general dentists use of SDF was the lack of coverage by insurance (54%).[24] This finding suggests that education alone is not enough to increase SDF usage. Insurance reimbursement will need to be better for practitioners to utilize SDF more as well.

General dentists reported not using SDF due to not having enough knowledge or education on SDF at a significantly higher rate compared to pediatric dentists. Ninety-five percent of pediatric dentists felt they had adequate training on SDF compared to only 59% of general dentists. However the percentage of general dentists comfortable with using SDF was much higher than a similar study in India where only 5.6% of the dentists or dental students felt they had enough knowledge on SDF.[20] Pediatric dentists were more willing to utilize SDF which was identical to the thesis from The Ohio State University.[24] The likely reason general dentists have less knowledge/ education on SDF compared to pediatric dentists in this study was because the majority of the participants who participated in this study have been practicing for over 10 years. Another reason that pediatric dentists have an increased knowledge and education in comparison to general dentists may be due to pediatric dentists treating more uncooperative children which may motivate the pediatric dentists to seek out CE on SDF.

The top three clinical situations that pediatric dentists reported utilizing SDF was for arresting dental caries in children with behavioral issues (80%), alternative treatment option to delay restorative treatment (70%), and when patients have severe dental anxiety (70%). This

finding was similar to the survey in regards to behavioral issues and medically fragile patients. They found that SDF was a good treatment option for children with behavioral issues (85%), medically fragile patients (85%), and dental anxiety (81%).[2] The percentage for medically fragile patients in this study was 25% lower (60% vs 85%) in comparison to the 2019 study.[2] One participant in this study stated, "my typical use of SDF is to avoid anesthesia in patients that do not wish to undergo anesthesia, are medically fragile, or to delay the need for anesthesia until an older age or to allow definitive anesthesia care once, and avoid relapse and repeat anesthetic care." This statement correlates with the top three clinical situations that SDF is utilized to provide care to patients who cannot have traditional dental treatment.

A limitation of this study was the low response rate (3.9%) of the survey. Due to the low response rate, it is difficult generalize the outcomes for all general and pediatric dentists in Virginia. Cross-sectional research allows for association but not causation. However, the responders compared to the overall population were well distributed. The Virginia Dental Association (VDA) includes general dentist members as well as specialists. The state of Virginia served as a proxy representation of the US as it contained a wide array of demographics. The state contained regions of high density, suburban, and rural regions. All general dentists that practice in Virginia may not be a member of the VDA who would not have been included in this study. As with all survey studies, self-reporting bias may have also occurred due to attitudes on performance and time constraints. In addition, participants were able to complete the survey multiple times.

Future research should involve a more inclusive population including more of the United States. This addition would allow for an increased number of participants and an increased distribution through the United States. Furthermore in regards to the question, "what was

included in your education about SDF," it would be beneficial to have additional answer choices "hands on application in residency" and "in-person lecture in residency." Seven percent of participants answered "other" to this question which could have included education in residency, thus, it may be helpful to have it included. Finally, future research could also include surveying dentists to see if their use of SDF would increase if SDF was approved by FDA for arresting caries.

Conclusion

The majority of the respondents in this survey were general dentists who most commonly utilized SDF for arresting caries in children with behavioral issues, for delaying restorative treatment, for medically fragile patients, for root caries, and for patients with severe dental anxiety.

Overall, practitioners who utilize SDF have more knowledge on SDF. Pediatric dentists reports more use on SDF and have more knowledge on SDF than general dentists. Pediatric dentists report they had an adequate amount of training on SDF compared to the general dentists. The practitioners who recently graduated from the dental school utilized SDF more than those who have been practicing longer. The practitioners who perceived adequate training were more likely to report the use of SDF than those who did not. It shows the importance of quality CE courses since that is where they are receiving their information on SDF. Increase in training and higher reimbursement amount could encourage the practitioners to use SDF.

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Use of Silver Diamine Fluoride in General Dentistry

STUDY TITLE: The Use of Silver Diamine Fluoride in General Dentistry

VCU INVESTIGATOR: [Jessica Eisenberg, DDS]

You are invited to participate in a research study to determine the utilization and current knowledge of silver diamine fluoride (SDF) in general dentistry. Your participation is voluntary.

In this study, you will be asked to take a 10- minute survey and answer questions about silver diamine fluoride. The survey is modified from an existing study instrument used to measure SDF education, knowledge, attitudes, and professional behavior in pediatric dentists. These questions will include questions about demographics and silver diamine fluoride. This will measure the practitioner's previous education, familiarity of silver diamine fluoride, and factors that affect their decision. Your name will not be linked to your response in any way.

After completion of the survey, an information sheet about SDF and an example of a SDF consent form can be downloaded.

If you have any questions, concerns, or complaints about this study now or in the future, please contact Jessica Eisenberg at (443)-845-3577, or eisenbergjn@vcu.edu.

Part of the survey provided by Antonioni MB, Fontana M, Salzmann LB, Inglehart MR. Pediatric Dentists' Silver Diamine Fluoride Education, Knowledge, Attitudes, and Professional Behavior: A National Survey. Journal of Dental Education. 2019;83(2):173-182. doi:10.21815/jde.019.020

Years since graduation (from DDS/DMD)

- ◯ Currently in Dental School
- ◯ Less than 3 years
- ◯ 3-5
- ◯ 6-9
- ◯ 10 +

Sex:

- ◯ Male
- ◯ Female
- ◯ Intersex
- ◯ Other
- ◯ Prefer not to specify

Please use the space provided if you wish to report your sex/gender identity:

_____

Please refer to the map when answering the following question.

Virginial Dental Association Components

Virginia Dental Association Component

- ◯ Tidewater Dental Association (Accomack and Northampton and cities of Norfolk, Portsmouth, Virginia Beach, Chesapeake, and Suffolk)
- ◯ Peninsula Dental Society (Middlesex, Mathews, Gloucester, York, James City, Charles City, and New Kent)
- ◯ Southside Dental Society (Isle of Wight, Southampton, Sussex, Surry, Prince George, Chesterfield, Dinwiddie, Greenville, Brunswick, Nottoway, Amelia, Prince Edward, Lunenburg, and Mecklenburg)
- ◯ Richmond Dental Society (King George, Westmoreland, Richmond, Lancaster, Essex, Caroline, King and Queen, King William, Hanover, Henrico, Louisa, Goochland, Powhatan, Fluvanna, Cumberland, Buckingham, and Northumberland)
- ◯ Piedmont Dental Society (Halifax, Charlotte, Campbell, Amherst, Pittsylvania, Bedford, Botetourt, Henry, Franklin, Roanoke, Craig, Appomattox, Bath, Alleghany, Patrick and Floyd)
- ◯ Southwest VA Dental Society (Carroll, Pulaski, Giles, Grayson, Wythe, Bland, Smyth, Tazewell, Washington, Russell, Buchanan, Dickenson, Wise, Scott, Lee, and Montgomery)
- ◯ Shenandoah Valley Dental Association (Fredrick, Clarke, Warren, Shenandoah, Page, Rockingham, Highland, Albemarle, Nelson, Augusta, and Rockbridge)
- ◯ Northern Virginia Dental Society (Arlington, Fairfax, Loudoun, Fauquier, Prince William, Stafford, Rappahannock, Culpeper, Madison, Orange, Green, and Spotsylvania)
- ◯ Unsure

Type of Dental Practitioner (select all that apply)

- ☐ General Dentist
- ☐ Pediatric Dentist
- ☐ Orthodontist
- ☐ Periodontist
- ☐ Endodontist
- ☐ Prosthodontist
- ☐ Oral Surgeon
- ☐ Other

Other type of practitioner:

_____

Type of practice (select all that apply currently)

- ☐ Solo practice
- ☐ Group practice
- ☐ Associate dentist
- ☐ Academia
- ☐ Corporate dentistry
- ☐ Community health
- ☐ Hospital dentistry
- ☐ Other

Other Practice Setting:

_____

Do you have any additional training (select all that apply)

- ☐ AEGD/ GPR
- ☐ Periodontics
- ☐ Endodontics
- ☐ Orthodontics
- ☐ Prosthodontics
- ☐ Other Residency

Other residency:

_____

Do you see patients in primary or mixed dentition?

◯ Yes
◯ No

What percentage of patients are in primary or mixed dentition?

0% 50% 100%

(Place a mark on the scale above)

Do you see patients with Smiles for Children dental benefits (ex. Medicaid/SCHIP)?

◯ Yes
◯ No

What percentage of patients are covered by Smiles for Children dental benefits (ex. Medicaid/SCHIP)?

0% 50% 100%

(Place a mark on the scale above)

Do you currently use Silver Diamine Fluoride (SDF) in practice?

◯ Yes
◯ No

Do you feel like you have adequate training on SDF?

◯ Yes
◯ No

Do you feel if you received more training then you would feel more comfortable using SDF?

◯ Yes
◯ Somewhat
◯ No
◯ Other

Please describe how else training will change your comfort level with SDF.

_____

Please use the scale provided to indicate how much you know about the use of SDF in dentistry

	1- Not at all familiar	2- Slightly familiar	3- Somewhat familiar	4- Moderately familiar	5- Very familiar
What SDF is used for in dentistry?	○	○	○	○	○
How SDF is used for the treatment of tooth hypersensitivity?	○	○	○	○	○
How SDF is used to treat dental caries in pediatric patients?	○	○	○	○	○
The advantages SDF treatment can have over traditional dental treatments?	○	○	○	○	○
The potential problems SDF usage can have?	○	○	○	○	○
Which, if any, codes SDF treatments can be billed under?	○	○	○	○	○

What was included in your education about SDF? (Select all that apply)

- ☐ Lecture in dental school
- ☐ In-person lecture in CE course
- ☐ Online dental course (not including in dental school)
- ☐ Online CE course
- ☐ Hands on application of SDF in dental school
- ☐ Self-guided learning
- ☐ Never received any education about SDF
- ☐ Other

Please describe anything else included in your education about SDF

_____

In what clinical situations do you use SDF? (select all that apply)

- ☐ Arresting dental caries in children with behavioral issues.
- ☐ When patients are medically fragile.
- ☐ When patients cannot pay for restorations.
- ☐ When patients have severe dental anxiety.
- ☐ When patients are undergoing or have recently undergone radiation therapy or chemotherapy.
- ☐ When patients take bisphosphonate medications.
- ☐ To avoid treatment under general anesthesia
- ☐ For patients with tooth hypersensitivity
- ☐ For patient with root caries
- ☐ Alternative treatment option to delay restorative treatment
- ☐ Other

Please describe any other clinical situations for which you use for SDF.

_____

Please use the scale provided to indicate (as a provider) how these factors influence the treatment choice of SDF?

	Major Deterrent	Deterrent	Neutral	Benefit	Major Benefit
Esthetics	○	○	○	○	○
Comfort level with applying SDF	○	○	○	○	○
Cost to provide SDF in your office	○	○	○	○	○
Cost of SDF for the patient	○	○	○	○	○
Patient/ Guardian's attitudes towards SDF	○	○	○	○	○
Reimbursement of SDF	○	○	○	○	○
Concern that SDF will not arrest caries	○	○	○	○	○
Off-label usage of SDF	○	○	○	○	○
Alternative treatment option to delay restorative treatment	○	○	○	○	○

Please use the scale provided to indicate how often you do or did use SDF for the following:

	Previously but no longer	Never	Rarely	Sometimes	Often	Very Often
While in dental school	○	○	○	○	○	○
In your office to treat tooth sensitivity	○	○	○	○	○	○
Off-label in your office to prevent dental caries	○	○	○	○	○	○
Off-label in your office to arrest dental caries in primary teeth	○	○	○	○	○	○
Off-label in your office to arrest dental caries in permanent teeth	○	○	○	○	○	○
Off-label in your office to arrest dental caries in special health care needs patients	○	○	○	○	○	○

Please describe your reason(s) for discontinuing use of SDF.

How do you utilize SDF? Select all that apply.

☐ 1 application of SDF
☐ 2 applications of SDF
☐ 1 application of SDF followed by an interim therapeutic restoration (ITR)/ atraumatic restorative treatment (ART) with materials such as; glass ionomers
☐ 2 applications of SDF followed by an interim therapeutic restoration (ITR)/ atraumatic restorative treatment (ART) with materials such as; glass ionomers
☐ Other

Please describe your procedure for applying SDF

Do you expect your future usage of SDF to:

○ Decrease a lot
○ Decrease a little
○ Not change
○ Increase a little
○ Increase a lot

Any additional comments or thoughts about SDF.

Thank you for your participation in this survey. Below are downloadable resources for the use of SDF in your practice including a chairside guide and a sample template for consent.

Thank you!

Chairside Guide for SDF

[Attachment: "SDF Chairside guide .pdf"]

Consent Form Sample

[Attachment: "Consent for SDF.pdf"]

Dear Dental Care Provider,

You are invited to participate in a research study conducted by VCU researcher Dr. Jessica Eisenberg. The purpose of this survey is to gather information on the use of silver diamine fluoride in general dentistry.

The VDA leadership supports Dr. Eisenberg in her research and would encourage you to provide your input on this important topic*. The results of this survey will help us better understand the use of SDF in general dentistry and the factors that affect the practitioners' decision.

This brief survey will take approximately 10 minutes to complete. Your participation is voluntary and all survey responses will be completely anonymous. Your consent is implied by agreeing to participate. Please take the survey by clicking the link below.

Take the Survey

This research study is approved by the VCU Institutional Review Board # HM20023939). If you have any questions or concerns about the survey, please contact Dr. Jessica Eisenberg at eisenbergjn@vcu.edu.

We sincerely thank you for your contribution to this study.

**The Virginia Dental Association is supporting Dr. Jessica Eisenberg and her VCU colleagues by sending emails to potential survey participants. No contact information or other personal has been provided to the research group or to anyone outside of the VDA.*

Chairside Guide: Silver Diamine Fluoride in the Management of Dental Caries Lesions*

Dental caries affects about one out of four children ages two through five years.[1] Silver diamine fluoride (**SDF**), recently approved for use in the United States, has been shown to be efficacious in arresting caries lesions.[2,3] It is a valuable therapy which may be included as part of a caries management plan for patients. Caries lesions treated with SDF usually turn black and hard. Stopping the caries process in all targeted lesions may take several applications of SDF, and reapplication may be necessary to sustain arrest.

Active cavitated caries lesions before application of SDF

SDF-treated lesions with temporary gingival staining

Case selection for application of silver diamine fluoride

Patients who may benefit from SDF include those:

- With high caries risk who have active cavitated caries lesions in anterior or posterior teeth;
- Presenting with behavioral or medical management challenges and cavitated caries lesions;
- With multiple cavitated caries lesions that may not all be treated in one visit;
- With dental caries lesions that are difficult to treat; and
- Without access to or with difficulty accessing dental care.

Criteria for tooth selection include:

- No clinical signs of pulpal inflammation or reports of unsolicited/spontaneous pain.
- Cavitated caries lesions that are not encroaching on the pulp. If possible, radiographs should be taken to assess depth of caries lesions.
- Cavitated caries lesions on any surface as long as they are accessible with a brush for applying SDF. (Orthodontic separators may be used to help gain access to proximal lesions.)

SDF can be used prior to restoration placement and as part of caries control therapy.[4] Informed consent, particularly highlighting expected staining of treated lesions, potential staining of skin and clothes, and need for reapplication for disease control, is recommended.

Clinical application of silver diamine fluoride

- Remove gross debris from cavitation to allow better SDF contact with denatured dentin.
- Carious dentin excavation prior to SDF application is not necessary. As excavation may reduce proportion of arrested caries lesions that become black, it may be considered for esthetic purposes.
- A protective coating may be applied to the lips and skin to prevent a temporary henna-appearing tattoo that can occur if soft tissues come into contact with SDF.
- Isolate areas to be treated with cotton rolls or other isolation methods. If applying cocoa butter or any other product to protect surrounding gingival tissues, use care to not inadvertently coat the surfaces of the caries lesions.
- Caution should be taken when applying SDF on primary teeth adjacent to permanent anterior teeth that may have non-cavitated (white spot) lesions to avoid inadvertent staining.
- Careful application with a microbrush should be adequate to prevent intraoral and extraoral soft tissue exposure. No more than one drop of SDF should be used for the entire appointment.
- Dry lesion with gentle flow of compressed air.
- Bend micro sponge brush. Dip brush into SDF and dab on the side of the plastic dappen dish to remove excess liquid before application. Apply SDF directly to only the affected tooth surface. Remove excess SDF with gauze, cotton roll, or cotton pellet to minimize systemic absorption.
- Application time should be at least one minute if possible. (Application time likely will be shorter in very young and difficult to manage patients. When using shorter application periods, monitor carefully at post-operative and recall visits to evaluate arrest and consider reapplication.)
- Apply gentle flow of compressed air until medicament is dry. Try to keep isolated for as long as three minutes.
- The entire dentition may be treated after SDF treatment with five percent sodium fluoride varnish to help prevent caries on the teeth and sites not treated with SDF.

* *Refer to AAPD Clinical Practice Guideline: Crystal YO, Marghalani AA, Ureles SD, et al. Use of silver diamine fluoride for dental caries management in children and adolescents, including those with special health care needs. Pediatr Dent 2017;39 (5):E135-E145. (Available at: http://www.aapd.org/policies/)*

Follow-up

Estimations of SDF effectiveness in arresting dental caries lesions range from 47 to 90 percent with one-time application depending on size of the cavity and tooth location.[4-7] Anterior teeth have higher rates of arrest than posterior teeth.[5] Therefore, follow-up for evaluation of caries arrest is advisable.[2-3]

- Follow-up at two to four weeks after initial treatment to check the arrest of the lesions treated.
- Reapplication of SDF may be indicated if the treated lesions do not appear arrested (dark and hard). Additional SDF can be applied at recall appointments as needed, based on the color and hardness of the lesion or evidence of lesion progression.
- Caries lesions can be restored after treatment with SDF.
- When lesions are not restored after SDF therapy, biannual reapplication shows increased caries arrest rate versus a single application.

References

1. Dye BA, Thornton-Evans G, Li X, Iafolla TJ. Dental caries and sealant prevalence in children and adolescents in the United States, 2011–2012. NCHS data brief, no 191. Hyattsville, Md.: National Center for Health Statistics. 2015. Available at: "https://www.cdc.gov/nchs/products/databriefs/db191.htm". Accessed September 6, 2017. (Archived in WebCite® at: "http://www.webcitation.org/6tX0D6qO1")
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3. Duangthip D, Jiang M, Chu CH, Lo EC. Restorative approaches to treat dentin caries in preschool children: Systematic review. Eur J Paediatr Dent 2016;17(2): 113-21.
4. Crystal YO, Niederman R. Silver diamine fluoride treatment considerations in children's caries management: Brief communication and commentary. Pediatr Dent 2016;38(7):466-71.
5. Fung M, Duangthip D, Wong M, Lo E, Chu C. Arresting dentine caries with different concentration and periodicity of silver diamine fluoride. JDR Clin Transl Res 2016;1(2):143-52.
6. Llodra JC, Rodriguez A, Ferrer B, Menardia V, Ramos T, Morato M. Efficacy of silver diamine fluoride for caries reduction in primary teeth and first permanent molars of schoolchildren: 36-month clinical trial. J Dent Res 2005;84(8):721-4.
7. Zhi QH, Lo ECM, Lin HC. Randomized clinical trial on effectiveness of silver diamine fluoride and glass ionomer in arresting dentine caries in preschool children. J Dent 2012;40(11):962-7.

CONSENT FOR SILVER DIAMINE FLUORIDE

Patient Name: _____

MR#: _____

DOB: _____

As parent or guardian for the above named patient, I am aware that that he/she will have a dental procedure performed, and have been informed of the risks of the procedure, advised of alternative treatments and the expected outcomes, as well as what could happen if the condition remains untreated.

I understand that Silver Diamine Flouride will be used for the patient's procedure and that the use of this medication was determined by many factors including the patient's physical and/or mental condition, the type of procedure that is planned, the dentist's preference, as well as my own desire.

I understand that Silver Diamine Fluoride (SDF) is an antibiotic liquid that is used on cavities to help stop tooth decay, and tooth sensitivity. It should not be used if the patient is allergic to silver, or there are painful sores or raw areas on the gums.

The following have been explained:

The Benefits of Silver Diamine Flouride are:

- SDF can help stop tooth decay.
- SDF can help relieve sensitivity.

Risks related to Silver Diamine Flouride include, but are not limited to:

- The affected area will stain ***black*** permanently.
  - Healthy tooth structure will not stain.
  - Stained tooth structure can be replaced eventually with a filling or a crown.
- Gum tissue may stain temporarily.
- There may be a metallic taste. This will go away rapidly.
- Every reasonable effort will be made to ensure the success of SDF treatment. There is a risk that the procedure will not stop the decay and no guarantee of success is granted or implied.

Alternatives to Silver Diamine Flouride, not limited to the following:

- No treatment, which may lead to continued deterioration of tooth structures and cosmetic appearance; Symptoms may increase in severity.

I hereby consent to the use of Silver Diamine Flouride.

I certify and acknowledge that I understand the risks, alternatives, and expected outcomes of Silver Diamine Flouride use, and that I had ample opportunity to ask questions and to consider my decision.

Signature of Patient or Parent/Legal Guardian	Date	Time	Relationship to Patient

Signature of Witness	Date	Time

MR Form # DENT.14 Originated: 12/26/16