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Use of caries prevention services in the Northwest PRECEDENT dental network

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Abstract

Objective—This cross-sectional study assessed the use of caries preventive services by Northwest PRECEDENT dental network practitioners and compared the caries experience of patients who received such services in the past 12 months with those who had not.

Methods—An oral health survey was conducted on approximately 20 patients seen by each of 97 private practice dental practitioners in the network. Eligible patients (total of 1877 aged 3–92) were randomly assessed for the occurrence of one or more new caries lesions as well as having received the following preventive services within the past 12 months: fluoride varnish or gel, sealant in molar or premolar, and prophylaxis. Patients were stratified by gender and age (1–17 years old, 18–64 years old, and 65+ years old). Logistic regression was used to investigate the association between the practitioner characteristics and the use of preventive services, as well as the preventive services and the presence of a new caries lesion in the past 12 months.

Results—The percent of patients in age category 1–17 years old / 18–64 years old / 65+ years old receiving each preventive treatment varied as follows: 95%/85%/81% for prophylaxis, 87%/24%/22% for fluoride, and 27%/2%/0% for sealant. There was a very limited association between the use of a specific preventive service and practitioner gender, and no significant association between use of services and practice location (rural, urban or suburban). There was a significant association between greater use of sealants for dentists with 0–15 years of practice experience as compared with those having more than 25 years of experience. For the 1–17 year old age group, males had about 1.7 times the odds of having a new lesion than females in the past 12 months, and patients receiving a sealant had 1.9 times the odds of having a new caries lesion. In the 18–64 year old group, receiving a prophylaxis in the past 12 months was significantly associated with lower odds for having a new lesion (odds ratio = 0.57).

Conclusions—This study reports that aside from prophylaxis, which more than 85% of the patients had received, about one-third of the patients overall received preventive services consisting of either sealants or some type of fluoride treatment in private dental practices in the Northwest PRECEDENT network.

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INTRODUCTION

There is relatively little information available about the use of preventive services, such as prophylaxis, fluoride (varnish or gel), and sealants, amongst private dental practitioners. However, the existing literature does suggest that the caries prevention approach in private practices in the U.S. is dependent upon many factors, including the age and knowledge of the practitioner, the age of the patient and their risk for future caries, and the compensation plan. Differences of opinion regarding personal experience with different treatments and their combinations, regional differences in dental education, and differences in the interpretation of the available literature regarding efficacy of the various caries prevention methods also likely contributes to variability. In addition, because of differences in social and environmental factors today in comparison to recent decades, it has been suggested that the prevention strategies that worked well in the past may no longer be as effective (1).

Cohen et al. (2) reported in a 1988 survey from over 1150 private dental practitioners that nearly two-thirds of the dentists used sealants, and that an average of 18.7% of patients younger than 18 had received sealants. Gonzalez et al. (3) surveyed dentists in Minnesota in 1991 and nearly all of the 375 responding claimed that they used sealants, with about 97.5% of the usage being in the 1–18 year age group and on average nearly 60% of those aged 6–14 years receiving them. Surveys of general dentists conducted in Ohio in 1989 and 1992 also showed that more than 90% of dentists claimed to use sealants, with 96.7% being for those patients between 1–17 years old, and with specific use being dependent on occlusal morphology and caries status (4). In a small survey of about fifty dentists in western New York in 2000, Frame et al. (5) reported that 73% of private practitioners recommended in-office fluoride applications for low-risk children, but only 22% recommended sealants for this group. In addition, only 22% recommended in-office fluoride for low-risk patients older than 30 years.

Fiset and Grembowski (6) showed in a 1995 survey of several hundred dentists in the state of Washington that fluoride varnish was being used for adult patients by approximately 32% of the dentists, and pit and fissure sealants by about 40%. In this study, the authors also discussed the acceptance of new therapies by general dentists. They first described a classic “s-shaped” time-to-adoption curve among the practitioners regarding the use of light-cured dental composites to demonstrate that the general adoption pattern predicted by others for diffusion of an innovation could also be applied to dentistry (7). The “s-shaped” curve relates to the introduction period where the use slowly rises, followed by the takeoff period with by a much more rapid adoption rate, and finally slow growth maturation phase where the last of the adopters come onboard. The time for nearly all of the practitioners to adopt light-curing technology, i.e. the maturation phase, was actually close to 10–12 years. Chapko (8) reported a similar time period for adoption of pit and fissure sealants by private practitioners and emphasized the role of opinion leaders in increasing the rate of adoption. These results are consistent with published reports on the time to adopt a new clinical technology or method in the medical community (9).

Fiset and Grembowski (6) then applied this principle to the adoption of sealants, fluoride varnish, and chlorhexidine for adults and found that the use of fluoride varnishes in 1995 was in the takeoff phase with about 32% of the practitioners having adopted this treatment method. The use of pit and fissure sealants in adults and chlorhexidine rinses for caries control did not seem to follow the classic curve, but showed about 40% of the practitioners using both. What was evident from the survey was that practitioners with a wider network of colleagues and with a greater knowledge base were typically quicker to adopt new technologies. However, the survey also showed that the decision not to adopt a technology, such as sealants for adults or fluoride varnishes, was related to cost or the lack of coverage

by insurance and a perceived lack of caries risk by the adult patients and thus reduced benefit to the procedure. Other survey-based studies have reached similar conclusions (4). In a repeat survey by Fiset and Grembowski (10) conducted in 1997 after the Washington State Dental Service began reimbursing for fluoride varnish, use had increased significantly, but only to 44% (from 32%), suggesting that reimbursement alone was not the most important factor. The majority of practitioners still had not adopted the practice, and its perceived lack of benefit, especially in a low caries population, was an important reason. In the second survey, use of chlorhexidine and sealants for adults had not changed.

Studies on the use of preventive services outside of the U.S. have shown similar frequency of use of sealants (11,12), with use was mostly confined to the young. Fluoride use also has been shown to be dependent upon the age of the patient, as well as socioeconomic status (13,14). Brennan and Spencer (14) showed in their 15-year survey of diagnostic and preventive trends in Australia that prophylaxis rates increased for adolescents and adults.

The data to support the use of the different preventive methods is mostly of variable quality, making it somewhat difficult to develop uniform strategies that can be applied on a large and diverse population demographic. Rozier (15) reported that there is strong evidence supporting the effectiveness of fluoride gel and varnish, as well as chlorhexidine gel, and resin sealants, for the prevention of caries in the permanent teeth of children and adolescents, but also noted that the effects of these strategies for patients at low risk of caries is weak. Bader et al., (16) found only fair evidence for the prevention of caries with the use of fluoride varnish in patients with active caries or high risk for caries, and incomplete evidence for any other prevention strategy, including sealants, prophylaxis, and chlorhexidine. Axelsson et al. (1) found moderate evidence for a combination of at least two caries preventive methods, with one being fluoride, for children and adolescents, but no effect could be demonstrated for elderly patients, and the effect of caries risk level also could not be established. Petersson et al (17) found limited evidence that fluoride varnish had a caries preventive effect in permanent teeth in children and adolescents, with insufficient evidence for adults or for primary teeth. Hiiri et al. (18) reported on four studies that presented some evidence for a greater effectiveness of sealants than fluoride varnish in the prevention of occlusal caries in 5–9 year old children, but they emphasized that the difference in effectiveness was not truly clear due to the small number of included trials. Mejare et al (19) concluded that the literature provided limited evidence for sealants on first molars, with incomplete evidence for other teeth, irrespective of caries risk. Ahovuo-Saloranta et al (20) also concluded that sealants could be recommended to prevent caries of the occlusal surfaces of permanent first molars, but that the relationship between success and the caries risk level could not be determined. The effect of fluoride (topical and water-based) in adults was reviewed by Griffin and Griffin (21), who concluded that fluoride had an annual affect of averting nearly one-quarter of new lesions in adults of all ages, and thus was effective.

The overall result of these many reviews seems to be that fluoride and sealants may be most effective in children and adolescents, but that the influence of caries status cannot be determined, nor can the effectiveness of these strategies be as clearly described for adult patients. The main reason for the ambiguity is the lack of studies of sufficient quality upon which to draw conclusions. Recent evidence-based clinical recommendations suggest that evidence is fairly strong for using sealants on permanent teeth in children and adolescents for caries prevention (class B), with a much lower strength of recommendation for adults (class D) (22). The evidence for caries prevention with the use of topical fluoride for children 6–18 years old is strong (mostly class A), but the evidence for adults is weak (class D), independent of their caries risk category (23). Thus, it is likely that the average practitioner, even one who keeps current in the literature in this area, has difficulty

formulating a clear pattern for the use of these preventive strategies without relying heavily on personal experience.

Thus, it is not surprising that more evidence on caries risk factors is needed to support more effective approaches for the prevention of dental decay worldwide. It is conceivable that the conduct of studies within recently formed networks of private and public health dental practices may provide an important avenue for the collection of this evidence now and in the future. This article describes the use of caries preventive services among the practitioners of one such network, Northwest PRECEDENT (**P**ractice-based **RE**search **C**ollaborative in **E**vidence-based **DE**ntistry). The primary focus of this cross-sectional study was to assess the use of caries preventive services by private dental practitioners in the Northwest PRECEDENT, and secondarily to compare the caries experience of patients who received such services in the past 12 months with those that had not.

METHODS

This study utilized the infrastructure of the Northwest PRECEDENT network which is composed of general dentists, orthodontists and pediatric dentists in the northwestern U.S. states of Idaho, Montana, Oregon, Utah and Washington. The data were collected September 2006 to July 2009 as a portion of a large survey of overall oral health status of patients in the practices of general dentists in the network. All general dentists who were members of Northwest PRECEDENT were invited to participate with a goal to accumulate data from 100 practices. A total of 1877 subjects aged 3–92 were randomly selected from the patient population of the 97 individual private practice providers participating in the study. By virtue of their decision to participate in practice-based research, the practitioner members of Northwest PRECEDENT are a self-selected cohort and may not be representative of all general dentists in the region. However, the participating dentists were relatively comparable demographically to other general dentists in the U.S., though they represent a slightly higher proportion of younger dentists and dentists practicing in rural communities (24). In any case, this study did involve a random sample of their patients, and therefore the data would seem to be generalizable to the overall population of patients visiting dental offices in the region.

Randomization was achieved by providing the practice with a starting appointment for enrollment, and then attempting to subsequently enroll every *n*th patient until 20 patients were enrolled. The patient interval was calculated from an algorithm incorporating the number of patients needed per practice, the average number of patients seen per day by the practice, and the desire to limit enrollment to no more than one patient per day to minimize disruption to the practice. Due to a need to finalize the study within a certain time frame, data from less than 20 patients was collected from a few of the practices. When the study was terminated, 93 dentists had enrolled 20 patients, 2 had enrolled 19 and 6 had enrolled 5 – 12 patients during an average of 2.5 months (standard deviation=2.9). Only the data from the 97 private dental practitioners (excluding those in community health clinics) participating was included in this study for a total of 1877 patient participants.

Various data were collected on the practitioner and patient demographics, as well as on the oral health status of the subjects, including whether they had received any of the following preventive services within the past 12 months: fluoride varnish or gel, sealant in molar or premolar, or prophylaxis. The occurrence of one or more new caries lesions was also recorded. The new lesion included recurrent decay, but not white spot lesions or defective margins around an existing restoration. The specific data for this study on use of prevention methods and caries experience were collected from the dental chart for each participating patient using the survey questions shown below:

Preventive Treatments in the Past 12 months

For each of the treatments listed below indicate whether the patient has received this treatment in the past 12 months, or received it at the recently completed visit (Yes or No):

Preventive Treatment—

- 1 Dental Prophylaxis
- 2 Topical Application of Fluoride (varnish)
- 3 Topical Application of Fluoride (includes APF, SnF or neutral NaF. Could be applied at any appointment, including prophylaxis).
- 4 Sealant Placed in Molar
- 5 Sealant Placed in Premolar

Caries Lesions in the Past 12 Months

- 6 Has the patient had 1 or more new caries lesions in the past 12 months? (including lesions diagnosed at the recently-completed visit) (Yes or No)
- 7 If yes, complete table showing tooth#, surfaces, and type of treatment.

Patients were stratified by gender and age (1–17 years old, 18–64 years old, and 65+ years old). As each patient's age was recorded, additional analyses were conducted using further stratifications of the age groups when warranted. Logistic regression using generalized estimating equations (GEE) was used to investigate the association between practitioner characteristics (gender, age, experience level, and location) as the independent variables and use of preventive services (dependent variable). Separate models were run for each age group and for each service (but sealants models were only run for the youngest age group, because there were not enough data in the other age groups to support a model with this many variables); thus there were 7 models in total. These models were adjusted for patient age and gender. GEE logistic regression, accounting for intraclass (within same practice) correlation, also was used to investigate the association between the preventive measures (independent variable) and the presence of at least one new caries lesion in the past 12 months (dependent variable). Within each age category, each preventive service was investigated in a separate regression, adjusting for patient age and patient gender. Since the 65+ age group had no sealants, this model was not run, and thus eight models were run in total.

RESULTS

The demographics of the 97 private practitioners from whom data was collected in this study are shown in Table 1. About one third of the practices were considered rural. The majority of practitioners were male, more than 50 years old, and had over 20 years of practice experience. The majority of patients were female (55%), between 18–64 years old (71%), with an equal distribution of younger (17 or less; 13%) and older (65 or more; 16%) patients. (Patient data not shown in table).

The use of prophylaxis was high in all age groups, but especially in the young, and was significantly different across age categories (Table 2). The percent of patients receiving any type of fluoride or sealant in the past 12 months varied by age group, always being highest for the 1–17 years old group and lowest for the 65 or older group. Of note is the fact that overall, nearly 55% of the patients surveyed, had experienced a new lesion within the past 12 months before the study visit. Of patients experiencing a new lesion, the average number of new lesions was just slightly less than 3. It should be noted that this number likely

represents a slight underestimate, as the survey form used in the study limited the practitioners to reporting on the ten most recent lesions in the past year. There is evidence that some patients exceeded ten lesions, but the additional ones were not recorded. While slightly lower for the eldest age group, the number of new lesions was not significantly different across the age categories. Though not reported in Table 2, males in the 1–17 year old age group had about 1.7 times the odds ($p = 0.03$) of having a new lesion in the past 12 months compared to females of the same age and treatment type (prophy, fluoride, or sealant).

Table 3 presents more detailed data for the youngest age group, where the vast majority of fluoride and sealant use occurred. This shows that use of prophylaxis was consistent across all of the age groups (in the under 18 category), though slightly lower for the youngest. The use of fluoride was lower among the oldest children (14–17 years), and sealant use was higher in the molars of children aged 6–9 years. Further stratification of the 18–65 years old age group into five subdivisions did not provide further discrimination of the data with respect to services provided, as there were no significant differences in prophylaxis, fluoride or sealants (Table 4). However, this further stratification identified a significantly higher level of new caries and number of new lesions in the past twelve months for the younger age subdivisions in this 18–64 years old group.

Table 5 presents the association between the use of preventive services in the 1–17 year old age group and practitioner characteristics, and shows that dentists who had 0–15 years experience were more likely to apply sealant, compared with those having more than 25 years experience. There was a trend in the same direction for the use of any fluoride, though this association was not statistically significant. Practice location did not have a statistically significant association with any of the preventive methods assessed. While not presented in Table 5, similar analyses for preventive services use in the other age groups showed higher odds ($OR=2.82$) for the use of prophylaxis in the 18–64 year-olds group for male clinicians than females ($p=0.002$).

Table 6 summarizes GEE results for the models regressing presence of new caries lesion on each of the three preventive services. In the 18–64 year old group, receiving a prophylaxis in the past 12 months was significantly associated with lower odds for having a new lesion ($OR=0.57$, 95% CI 0.40–0.81), controlling for patient age and gender. The odds ratio for the other age groups was not significant for prophylaxis. Patients in the 1–17 year old age group receiving a sealant in the past 12 months had 1.90 (1.02 – 3.55) times the odds of having had a new lesion during that time period, compared with patients of same age and gender who did not receive a sealant. Fluoride did not have a significant association with a new lesion for the two younger age groups, but for those in the 65+ years old group, fluoride placement was associated with significantly greater odds of having had a new lesion in the past 12 months.

DISCUSSION

The use of preventive procedures, aside from prophylaxis, which was high in all age groups, was mostly confined to the younger patients, less than 18 years old (Table 2). This result is consistent with results from previous studies (2–4). The higher percentage of sealant use in the younger age group is likely due to availability of insurance coverage, typically not available for adult patients, and also may reflect the high quality of evidence available to support sealant use in this age group as explained in ADA guidelines (11). Our survey showed that slightly more than one quarter of the patients in the 1–17 years age range had a sealant placed, and this is slightly lower than the overall percentage (about 29–38%) of children and adolescents, aged 6–19, who have at least one permanent tooth sealed

according to the NHANES report (24). The difference is likely due to the fact that the current survey examined only the past 12 months, and did not include sealants placed before that. The sealant use in our study was also much lower than the 60% reported in a previous survey (3), but this may also reflect the fact that our study collected data based on documented use, and not the clinician's recollection of use. The low percent use of fluoride in the middle and older age groups was likely due to reduced compensation for these services by insurance after the teen years, unwillingness of patients to pay out of pocket for such services, and reduced expectation of beneficial effect. Even without considering the compensation plan, this behavior may be due to the lack of available clinical trials and high quality data demonstrating the efficacy of these strategies for all caries risk groups.

It is important to note that the first survey by Fiset and Grembowski (6) was conducted nearly 14 years ago, but the relatively low use of sealants and fluorides, especially in adults, is still evident from the data in this current study. It is likely that the reasons for the low level of usage in the NWP network are the same as those cited in the previous survey. It is also interesting that over this time frame, the use of fluoride varnish, which was used for only about 12% of the patients, and mostly the young (about 30%), was even lower than reported in the 1995 survey. Again, this difference may be due to the fact that the current study was not simply a survey, but an actual auditing of patient records and may reflect more accurately the true use of these services than an unsubstantiated survey. It is obvious that the medical model of caries, which includes a heavy emphasis on preventive strategies rather than restorative, has yet to become the standard within this network of private practitioners, as concluded by Fiset and Grembowski in 1997 (6). In other parts of the world, a more proactive approach may be being used. For example, in the United Kingdom, a booklet entitled "Delivering Better Oral Health. An evidence-based toolkit for prevention" is produced by the Department of Health and is sent to all general dental practitioners and salaried primary care dentists (http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_102982.pdf).

The greater use of sealants (and a trend for fluoride) by the dentists with less practice experience may reflect an educational difference as compared with practitioners graduating from dental school many years earlier, when there may have been less emphasis on the same preventive procedures. Perhaps further surveying of the participating dentists as to their practice philosophy would have provided more definitive reasons for the observed differences. However, overall there were few differences in practice behavior based on dentist characteristics, suggesting a very uniform approach to prevention in this group of clinicians.

The fact that more than half of the patients in this random selection experienced a new lesion in the past 12 months, independent of age group, was rather surprising. Data from the NHANES survey from the CDC showed high rates (42%) of caries experience (treated or untreated decay) in children and adolescents aged 6–19 years, and coronal caries experience in adults (91%), but the percent of the young and adults that had untreated lesions was 14% and 23%, respectively (25,26). As the data from the NHANES study of 1999–2002 was not supplemented with radiographs, and is limited to untreated lesions, there is a possibility that the NHANES study underestimates lesion frequency. Though it is possible that the rate of caries development in this survey population in the Northwest PRECEDENT network actually may be higher than that reported nationally in the NHANES survey, it must be noted that the present survey was conducted on patients presenting for a scheduled dental appointment, and this could contribute to an overestimate compared to the general population. In any case, one must be careful in relating these results to the entire population

because the sample is limited only to active patients of these participating private practices in the Northwestern United States.

A logical consideration in light of these results would be to relate the availability of fluoridated water to caries rate for the patients in this study. The patients in this survey come from a large geographical area having many local variations in this parameter, thus making this difficult to determine. But initial assessments of caries and fluoridation by state have not shown a relationship between lower caries and higher fluoride availability.

The reason that males aged 1–17 had nearly twice the odds of having a new lesion than females in the past 12 months cannot be determined from this study. One may conjecture that it is related to an increased awareness of oral hygiene and greater willingness to spend time on oral hygiene by girls than boys in the teen and pre-teen years. However, this result is somewhat at odds with the NHANES survey that showed the presence of dental decay to be slightly higher for girls than boys aged between 6–19 years (25,26).

In the middle age group, the lower odds for a new lesion among patients who had prophylaxis treatment in the last 12 months would not be unexpected. But the opposite relation for sealants in the young suggests that sealants may often not be prescribed until a caries lesion appears somewhere in the mouth, or that a sealant has failed, or that the practitioner made a decision about using sealants based on the caries risk and status of the patient at the time, which ultimately changed. As the initial caries status and risk of the patients were not controlled for, this is a potential confounder in interpreting this result. But these possibilities are supported by data from previous studies in which the frequency of sealant use for patients was increased with the presence of caries, and more specifically, with the extent of the lesions (4). In another study concentrating mostly on the affects of pre- and post-eruption fluoride exposure on caries, sealant use was also assessed, and the presence of pit and fissure sealants on 1–2 tooth surfaces was associated with significantly increased DMF scores for first molar surfaces, while their presence on 3–8 surfaces was associated with significantly decreased DMF scores for first molar surfaces (26).” A similar pattern of the use of fluoride in reaction to existing decay was recognized by Tickle et al. (13) in the United Kingdom, and Rindal et al. (28) in the United States. However, Ismail and Gagnon (29) showed more significant use of sealants by private practitioners in Montreal, Canada, for children aged 6–9 years who were free of caries, with 11.6% and 17.5% of the children receiving new sealants in the first and second years of their study, respectively. It is also possible that patients do not present to a dentist until they realize based on symptoms that they have a problem. Thus, caries may be well-established by the time they are seen by the dentist, and sealants would then be applied as an overall treatment and prevention strategy in a patient already having a significant amount of caries. It is likely that various explanations are responsible for the associations between caries and preventive services observed in this study. Further, though it is possible that there is a direct causal relationship between a specific factor and the presence of decay, it is not likely that there is only one such relationship. In addition, as no baseline data was obtained in this study regarding the caries experience or risk factor for each patient, it is not possible to make any definitive statements at this point about the nature of the relationships, other than to state that they exist.

CONCLUSION

This study in the Northwest PRECEDENT dental network reports a relatively modest overall use of preventive services (about 32% of all the patients received fluoride and about 5% received sealants) other than prophylaxis (nearly 86% of all patients receiving). The use of sealants was basically confined to molars in the 1–17 year old age group (26.4% of

children receiving), with virtually no usage in adults. The vast majority of fluoride use was related to gel application in the 1–17 year old group (64.0%), with minimal use for adults (around 16% fluoride gel use). Fluoride varnish was used only for about 12% of the study population and primarily in the young.

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Table 1Demographic information for the 97 practitioners[#]

		percentage of dentists	number of dentists
Gender	Male	88.7 %	86
	Female	11.3 %	11
Clinician Age (years):	≤30	5.2 %	5
	31–40	19.6 %	19
	41–50	19.6 %	19
	51–60	50.5 %	49
	>60	5.2 %	5
Experience (years):	≤5	11.3 %	11
	6–15	19.6 %	19
	16–20	12.4 %	12
	21–25	27.8 %	27
	>25	28.9 %	28
Practice Location	Rural	31.5 %	28
	Suburban	46.1 %	41
	Urban	22.5 %	20

[#] Note that most categories add to less than 97 due to incomplete information being provided.

Table 2

Percentage (95% confidence interval) of patients in each age category receiving each of the preventive treatments in the past 12 months, or with new caries lesions in the past 12 months. Last row is the mean (95% CI) number of new caries among patients with new caries.

	1–17 years old (n = 241)	18–64 years old (n = 1340)	65+ years old (n = 296)	Total (n = 1877)
Prophylaxis^{##}	95.3 (92.5, 98.1)	85.1 (81.7, 88.5)	80.8 (75.7, 85.9)	85.7 (82.8, 88.6)
Any fluoride[*]	86.9 (80.8, 92.9)	24.1 (17.3, 31.0)	21.9 (13.3, 30.5)	31.9 (25.9, 37.9)
(1) Varnish[*]	30.2 (20.8, 39.6)	9.2 (4.8, 13.7)	9.0 (2.8, 15.2)	11.9 (7.5, 16.3)
(2) APF, SnF₃, neutral NaF[*]	64.0 (54.4, 73.6)	16.4 (10.4, 22.4)	14.2 (7.6, 20.8)	22.2 (16.9, 27.5)
Any sealant[*]	27.2 (21.2, 33.2)	1.5 (0.7, 2.2)	0	4.5 (3.3, 5.8)
(1) Molar[*]	26.4 (20.3, 32.4)	1.3 (0.6, 2.0)	0	4.3 (3.1, 5.5)
(2) Premolar[*]	4.3 (0.6, 8.0)	0.5 (0, 1.0)	0	0.9 (0.3, 1.5)
% of age group with new caries lesion in past 12 months	55.6 (48.5, 62.7)	55.0 (50.9, 59.0)	53.0 (46.8, 59.3)	54.7 (51.2, 58.2)
mean # of new caries lesions in past 12 months (for those with new lesion)	2.98 (2.50, 3.45) (n = 134)	2.93 (2.69, 3.16) (n = 736)	2.54 (2.20, 2.87) (n = 157)	2.87 (2.67, 3.07) (n = 1027)

^{*} Chi-square tests were performed for each treatment and showed statistically significant ($p \leq 0.01$) differences by age category

[#] There were missing observations for each treatment that were distributed across all age groups as follows: prophylaxis – 37; any fluoride – 51; varnish – 51; APF, etc. – 53; any sealant – 41; molar sealant – 40; premolar sealant – 42.

Table 3

Percentage of 1–17 year old patients receiving each of preventive services in the past 12 months

	< 6 years old (n = 23)	6–9 years old (n = 55)	10–13 years old (n = 94)	14–17 years old (n = 69)	Total for <18 group (n = 241)
Prophylaxis	87.0 (69.4, 100)	94.4 (87.9, 100)	97.8 (94.7, 100)	95.6 (90.5, 100)	95.3 (92.5, 98.1)
Any fluoride *	91.3 (71.7, 100)	92.6 (83.4, 100)	90.1 (83.0, 97.2)	76.5 (63.2, 89.7)	86.9 (80.8, 92.9)
(1) Varnish	43.5 (18.8, 68.2)	37.7 (17.6, 57.8)	26.4 (15.5, 37.2)	25.0 (11.9, 38.1)	30.2 (20.8, 39.6)
(2) APF, SnF neutral NaF	56.5 (24.5, 88.6)	64.2 (45.3, 83.0)	67.4 (54.9, 79.9)	61.8 (46.7, 76.8)	64.0 (54.4, 73.6)
Any sealant *	4.5 (0, 14.9)	55.6 (42.7, 68.4)	26.1 (17.3, 34.9)	13.4 (3.8, 23.1)	27.2 (21.2, 33.2)
(1) Molar *	4.5 (0, 14.9)	53.7 (40.7, 66.7)	25.0 (16.0, 34.0)	13.4 (3.8, 23.1)	26.4 (20.3, 32.4)
(2) Premolar	0	5.7 (0, 12.2)	6.5 (1.3, 11.7)	1.5 (0, 4.5)	4.3 (0.6, 8.0)

* Chi-square tests were performed for each treatment and showed statistically significant ($p \leq 0.05$) differences by age category

There were missing observations for each treatment that were distributed across all children's age groups as follows: prophylaxis – 5; any fluoride – 5; varnish – 6; APF, etc. – 5; any sealant – 6; molar sealant – 6; premolar sealant – 7.

Table 4

Percentage of 18–64 year old patients receiving each of preventive services in the past 12 months, or with new caries lesions in the past 12 months. Last row is the mean (95% CI) number of new caries among patients with new caries.

	18–24 years old (n = 128)	25–34 years old (n = 219)	35–44 years old (n = 287)	45–54 years old (n = 383)	55–64 years old (n = 323)	Total (n = 1340)
Prophylaxis[#]	84.7 (76.7, 92.6)	88.4 (83.3, 93.4)	84.4 (78.7, 90.1)	86.4 (82.5, 90.3)	82.1 (76.2, 87.9)	85.1 (81.7, 88.5)
Any fluoride	32.5 (21.4, 43.7)	23.0 (14.3, 31.7)	23.1 (14.3, 31.8)	23.5 (15.2, 31.7)	23.6 (15.3, 32.0)	24.2 (17.3, 31.1)
(1) Varnish	10.7 (5.0, 16.4)	11.2 (5.3, 17.1)	7.8 (2.3, 13.3)	7.8 (2.1, 13.5)	10.2 (4.7, 15.6)	9.2 (4.8, 13.7)
(2) APF, SnF neutral NaF	24.6 (13.6, 35.6)	13.6 (6.6, 20.7)	17.7 (9.9, 25.5)	16.2 (9.3, 23.2)	14.1 (6.7, 21.5)	16.4 (10.4, 22.4)
Any sealant	5.7 (1.9, 9.6)	1.9 (0.4, 4.2)	2.1 (0.4, 3.8)	0.5 (0, 1.3)	0	1.5 (0.7, 2.2)
(1) Molar	5.7 (1.9, 9.6)	1.9 (0.4, 4.2)	1.8 (0.2, 3.3)	0.3 (0, 0.8)	0	1.3 (0.6, 2.0)
(2) Premolar	1.6 (0, 3.9)	0.9 (0, 2.3)	0.4 (0, 1.1)	0.5 (0, 1.3)	0	0.5 (0.0, 1.0)
% of age group with new caries lesion in past 12 months[*]	69.5 (61.2, 77.9)	61.2 (54.1, 68.2)	51.2 (44.5, 57.9)	53.3 (47.6, 58.9)	50.2 (44.0, 56.3)	54.9 (50.9, 59.0)
mean # of new caries lesions in past 12 months (for those with new lesion)[*]	3.84 (3.23, 4.45) (n = 89)	3.49 (3.01, 3.96) (n = 134)	3.20 (2.70, 3.71) (n = 147)	2.35 (2.05, 2.64) (n = 204)	2.43 (2.14, 2.73) (n = 162)	2.93 (2.69, 3.16) (n = 736)

* Chi-square tests were performed for each treatment and none showed statistically significant differences by age category: Prophyl (p=0.3), Fluoride (p=0.3), Fluoride Varnish (p=0.5), Other Fluoride (p=0.08). Sealants resulted in extremely sparse cells, so p-values not reported.

* Difference, by age group, in % of age group with new caries lesion in last twelve months is statistically significant (Chi-square test p-value < 0.001), as is mean # of new caries (p < 0.001).

[#] There were missing observations for each treatment that were distributed across all age groups as follows: prophylaxis – 27; any fluoride – 38; varnol sealant – 31; premolar sealant – 32.

Table 5

Association between practitioner characteristics and use of preventive procedures (1–17 year-olds)

Odds ratio (95% CI) p-value		Prophy	Any Fluoride	Any Sealant
Clinician Gender – Male (compared with Female)		0.97 (0.19, 5.00) p = 0.97	1.17 (0.34, 4.08) p = 0.81	1.46 (0.66, 3.21) p = 0.35
Dentist Years of Experience (compared with >25 years)	0–15 years	1.88 (0.43, 8.14) p = 0.40	2.44 (0.60, 10.00) p = 0.22	2.10 (1.00, 4.42) p = 0.05
	16–25 years	1.64 (0.42, 6.37) p = 0.48	0.93 (0.24, 3.53) p = 0.91	1.24 (0.50, 3.05) p = 0.64
Practice Location (compared with urban)	Rural	1.34 (0.31, 5.82) p = 0.69	0.76 (0.24, 2.40) p = 0.64	0.76 (0.24, 2.40) p = 0.64
	Sub urban	1.20 (0.41, 3.50) p = 0.74	1.43 (0.36, 5.65) p = 0.61	0.49 (0.17, 1.42) p = 0.19

Note that these models were adjusted for patient age and gender

Table 6

Association between predictors and the outcome of having a new lesion in the past 12 months.

Odds ratio (95% CI) p-value	1–17 years old	18–64 years old	65+ years old
Prophylaxis	1.74 (0.54,5.61) p = 0.35	0.57 (0.40,0.81) p = 0.002	0.95 (0.52,1.73) p = 0.87
Any fluoride	1.19 (0.54,2.64) p = 0.67	1.12 (0.83,1.52) p = 0.45	1.78 (1.02,3.11) p = 0.04
Any sealant	1.90 (1.02,3.55) p = 0.04	3.56 (0.73,17.40) p = 0.12	none used

Note that the these models were adjusted for patient age and gender