Title: COVID-19 Impact on Childhood Caries and Potential Mitigation from Sealants

Authors: Christina Scherrer, Shillpa Naavaal, Mei Lin, Susan O Griffin

APPENDIX

Appendix Table 1. Percentage of permanent first molars among children with 4 erupted first molars with dental sealants, National Health and Nutrition Examination Survey, 2011–2016.

	Percentage of permanent first molars with sealants			
Age (years)	All	Non-Hispanic White	Non-Hispanic Black	Hispanic
6–11	34.75	38.46	26.63	35.47
6	17.88	15.85	13.90	28.65
7	29.22	29.80	15.91	32.50
8	40.00	44.72	32.68	39.06
9	37.88	39.74	36.86	35.48
10	40.30	48.24	32.50	39.48
11	35.51	40.21	22.90	34.68

Appendix Table 2. Adjustment to parameters to obtain estimates for racial/ethnic groups

Initial state of 1M	Probability 1M in state, all children age 6 years[a]	Probability 1M in state, children age 6 to 11 years by race/ethnicity[a]				Adjustment Factor[a]		
		All	Non-Hispanic White	Non-Hispanic Black	Hispanic	Non-Hispanic White	Non-Hispanic Black	Hispanic
Untreated caries	0.005	0.024	0.028	0.028	0.021	1.131	1.136	0.874
Filled	0.014	0.089	0.064	0.102	0.102	0.721	1.140	1.141
Sealed	0.179	0.347	0.385	0.266	0.355	1.107	0.766	1.021
Not-sealed, no caries	0.802	0.539	0.524	0.604	0.522	NA	NA	NA

Abbreviations: 1M, first permanent molars; NA, not applicable.

[a] Adjustment factor estimated from 2011–2016 National Health and Nutrition Examination Survey data for children age 6 to 11 years. The factor equaled the probability for first molars among children in a racial/ethnic group divided by the probability for first molars among all children. For example, adjustment factor for first molars among non-Hispanic White children being in untreated decayed state equaled 0.028/0.024=1.131. Adjustment factors were not used in the not-sealed, no caries category since that probability was calculated as 1-the sum of the other categories.

Probabilities used in simulation model for first molars among children in a racial/ethnic group equaled value for all children age 6 years multiplied by the adjustment factor for the racial/ethnic group. For example, probability 1Ms among Non-Hispanic White children were in untreated caries state at the beginning of the modeling horizon equaled 1.131*0.005=0.006.

Appendix Table 3a. Dental caries attack rate (AR) calculations for children of all race/ethnicities.

Age (years)	Years 1M in mouth	Number of children with no sealants[a]	Sum of decayed/filled 1M among children with no sealants[a]	AR for years elapsed[b]	**AR for one year[c]**	Weighted by proportion of children in age group
7	1	1,309,414	305,605	5.83%	**5.83%**	1.21%
8	2	1,180,373	595,745	12.62%	**6.52%**	1.22%
9	3	1,038,866	901,910	21.70%	**7.83%**	1.29%
10	4	846,440	854,138	25.23%	**7.01%**	0.94%
11	5	923,759	1,022,734	27.68%	**6.28%**	0.92%
12	6	999,180	1,271,078	31.80%	**6.18%**	0.98%
					Weighted average one-year AR for age 7–12 years: **6.57%**	

Abbreviations: 1M, first permanent molars.

[a]Estimated from National Health and Nutrition Examination Survey data 2011–2016.

[b]Equals sum of decayed or filled first molars among children with no sealants divided by 4 times the number of children.

[c]Equals 1-(1-attack rate for years elapsed)^(1/years first molar in mouth).

Appendix Table 3b. Dental caries attack rate (AR) calculations for non-Hispanic White children.

Age (years)	Years 1M in mouth	Number of children with no sealants[a]	Sum of decayed/filled 1M among children with no sealants[a]	AR for years elapsed[b]	**AR for one year[c]**	Weighted by proportion of children in age group
7	1	494,077	77,950	3.94%	**3.94%**	0.84%
8	2	500,071	157,972	7.90%	**4.03%**	0.87%
9	3	365,607	281,092	19.22%	**6.87%**	1.08%
10	4	269,542	324,859	30.13%	**8.57%**	1.00%
11	5	315,628	336,321	26.64%	**6.01%**	0.82%
12	6	369,642	360,139	24.36%	**4.55%**	0.73%
					Weighted average one-year AR for age 7–12 years: **5.34%**	

Abbreviations: 1M, first permanent molars.

[a]Estimated from National Health and Nutrition Examination Survey data 2011–2016.

[b]Equals sum of decayed or filled first molars among children with no sealants divided by 4 times the number of children.

[c]Equals 1-(1-attack rate for years elapsed)^(1/average time first molar in mouth).

Appendix Table 3c. Dental caries attack rate (AR) calculations for non-Hispanic Black children.

Age (years)	Years 1M in mouth	Number of children with no sealants[a]	Sum of decayed/filled 1M among children with no sealants[a]	AR for years elapsed[b]	**AR for one year[c]**	Weighted by proportion of children in age group
7	1	314,319	79,908	6.36%	**6.36%**	1.34%
8	2	235,460	183,540	19.49%	**10.27%**	1.62%
9	3	199,824	161,955	20.26%	**7.27%**	0.97%
10	4	214,868	222,015	25.83%	**7.20%**	1.04%
11	5	245,789	218,551	22.23%	**4.90%**	0.81%
12	6	282,846	404,189	35.73%	**7.10%**	1.35%
					Weighted average one-year AR for age 7–12 years: **7.12%**	

Abbreviations: 1M, first permanent molars.

[a]Estimated from National Health and Nutrition Examination Survey data 2011–2016.

[b]Equals sum of decayed or filled first molars among children with no sealants divided by 4 times the number of children.

[c]Equals 1-(1-attack rate for years elapsed)^(1/average time first molar in mouth).

Appendix Table 3d. Attack rate (AR) calculations for Hispanic children.

Age (years)	Years 1M in mouth	Number of children with no sealants[a]	Sum of decayed/filled 1M among children with no sealants[a]	AR for years elapsed[b]	**AR for one year[c]**	Weighted by proportion of children in age group
7	1	411,737	147,747	8.97%	**8.97%**	1.85%
8	2	350,955	205,898	14.67%	**7.62%**	1.34%
9	3	379,874	313,557	20.64%	**7.41%**	1.41%
10	4	283,004	248,786	21.98%	**6.02%**	0.85%
11	5	309,109	359,106	29.04%	**6.63%**	1.03%
12	6	263,400	432,311	41.03%	**8.43%**	1.11%
					Weighted average one-year AR for age 7–12 years: **7.59%**	

Abbreviations: 1M, first permanent molars.

[a]Estimated from National Health and Nutrition Examination Survey data 2011–2016.

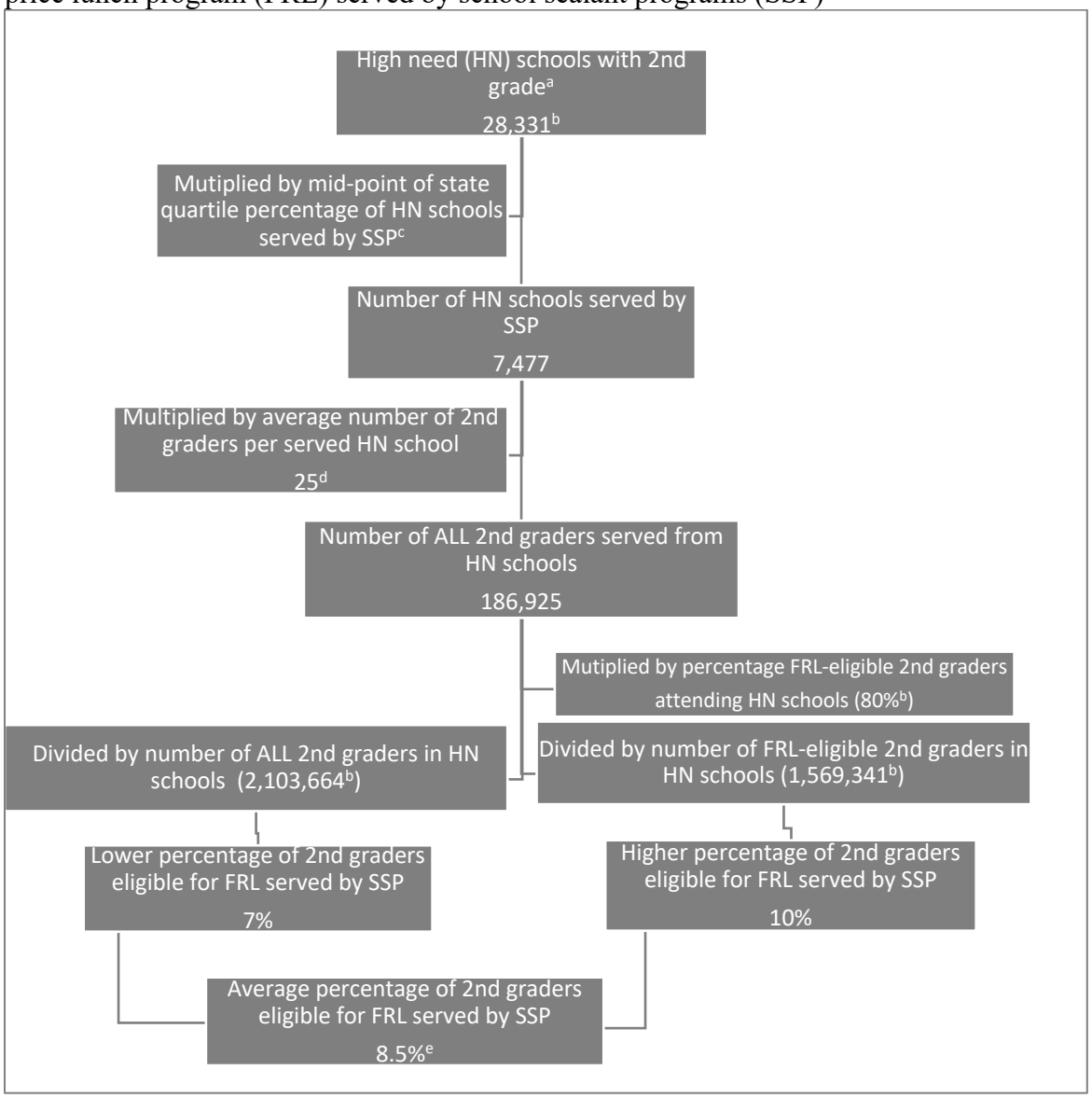
[b]Equals sum of decayed or filled first molars among children with no sealants divided by 4 times the number of children

[c]Equals 1-(1-attack rate for years elapsed)^(1/average time first molar in mouth)

Appendix Table 4. Prevalence of past year dental visit by year of age, Medical Expenditure Panel Survey 2015–2018.

Age (years)	Percentage with last year dental visit (standard error)
6	52.0 (2.0)
7	51.9 (1.9)
8	50.6 (2.0)
9	48.6 (1.9)
10	48.8 (2.2)
11	48.3 (2.1)

Appendix Figure 1. Flow chart to estimate percentage of 2nd graders eligible for free or reduced-price lunch program (FRL) served by school sealant programs (SSP)



Abbreviations: FRL, free or reduced-price lunch program; SSP, school-based sealant programs; HN, high needs; NCES, National Center for Education Statistics; CDC, Centers for Disease Control and Prevention; ASTDD, Association of State and Territorial Dental Directors; 1M, first permanent molars; NHANES, National Health and Nutrition Examination Survey.

[a] HN schools refer to schools with ≥50% of students eligible for FRL.

[b] Estimated using the NCES Elementary/Secondary Information System data for 2018–2019 school year: https://nces.ed.gov/ccd/elsi/.(US Department of Education)

[c] The Pew Charitable Trusts. States stalled on dental sealant programs – A 50-state report. 2015. https://www.pewtrusts.org/-/media/assets/2015/04/dental_sealantreport_final.pdf. (The Pew Charitable Trusts 2015)

[d] Estimated with data from 17 states funded by CDC for SSPs and ASTDD's 2020 Synopses of State Dental Public Health Programs.

[e] Finally, 7.23% of all teeth are sealed by SSP, derived through multiplying 8.5% by the child-level proportion of 1Ms with sealants among children with at least 1 sealant (3.4/4, estimated from NHANES data 2011–2016, see citation below). Since at time 0, 80.2% of teeth are eligible for sealing on average (Table 1) and this decreases to approximately 64.7% at the end of the first year, 7.23/((.802+.647)/2)= 9.97% of eligible teeth are sealed by SSPs in year 1 during the 9 non-summer months.

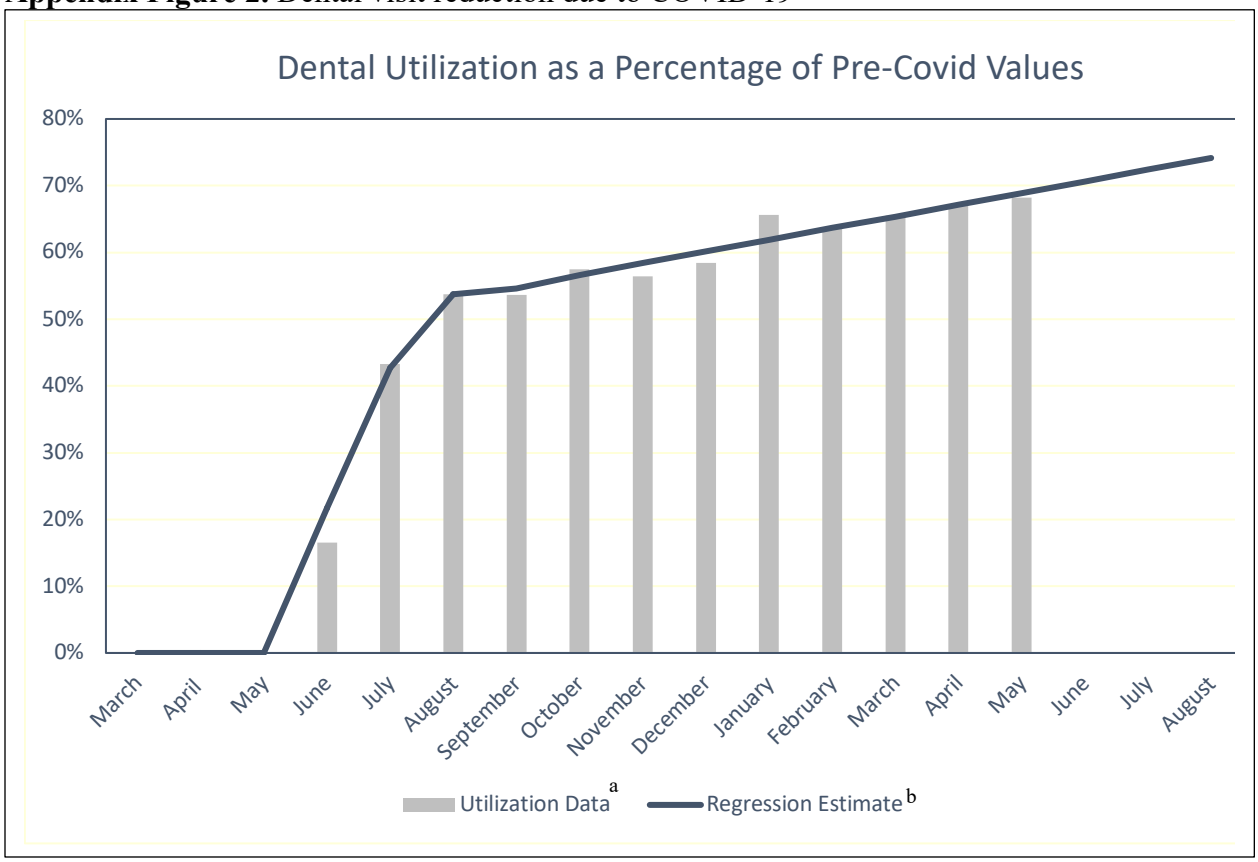
Appendix Table 5. Solving for probability permanent first molar sealed during dental visit[a]

	Not sealed untreated caries or filled	Sealed	Not sealed no caries
March 2020	0.019	0.179	0.802
February 2021	0.072	0.340	0.588
February 2022	0.110	0.386	0.504
February 2023	0.143	0.421	0.436
February 2024	0.172	**0.391**	0.436

[a]Parameter values: At initiation sealed =0.179 and Not sealed, no caries (i.e., no untreated or filled caries (NSNC)) =0.802 for children from low-income households age 6 (Table 1); probability of dental visit (DV)=0.5021 (Table 1); Attack rate (AR)=0.066 (Appendix Table 3a); sealant loss rate conditioned on being retained previous year (1-Ri) in years 1, 2, 3, and 4=0.106, 0.092, 0.080, and 0.070, respectively, and probability first molar sealed by SSP in first year (SSPsealant)=0.0997 (Appendix Figure 1).

We next iteratively solved for the probability permanent first molars are sealed during dental visit (DVsealant) based on model assumptions and the above parameter values, including SSPsealant, such that the proportion of first molars in the sealed state at 48 months was 0.391 (proportion in sealed state for children aged 9 and 10).

Appendix Figure 2. Dental visit reduction due to COVID-19



[a] Utilization Data: Using American Dental Association (ADA) publicly available survey data from public health practices from the middle of each month (see citation below) the percentage of practices that responded that they were "open and business as usual" each month were added to 50% of the practices that responded that they were "open but with lower patient volume than usual".

ADA Health Policy Institute. *COVID-19 Economic Impact - State Dashboard*. COVID-19 Economic Impact on Dental Practices 2021 [cited 2021]; Available from: https://www.ada.org/en/science-research/health-policy-institute/covid-19-dentists-economic-impact/survey-results.

[b] Regression Estimate: One regression analysis was done for model values for June 2020 through August 2020. A second linear regression was done on data through May 2021 forward. Due to information showing that many dentists plan to stop taking Medicaid patients and an expected long-term reduction in capacity due to infection control measures (See citation below) future capacity was capped at 90% of pre-COVID levels once reaching that value (May 2022) through the end of the modeling horizon.

ADA Health Policy Institute (2020). The impact of COVID-19 on the dental care sector: Insights from data for the week of November 30th. Available from: https://www.ada.org/~/media/ADA/Science%20and%20Research/HPI/Files/HPI_COVID_Webinar_Dec_2020_1.pdf?la=en (Slides 16,17 and 2).

Appendix Table 6. Calculation of model outcomes

	In each, the estimate from each replication was averaged with the other (999) replications to obtain the final point estimate and standard errors.
DALYs per 1000 children over 4 years	Across the 4,000 teeth and 48 months in a replication, the total number of months each tooth was in the untreated decay state (NSC) were counted. That total was divided by the average number of decayed teeth per child with a decayed tooth[a] and divided by 12 months per year to estimate the number of years of decay that 1,000 children would have experienced. That number was multiplied by the DALY weight randomly generated for that replication to obtain DALYs per 1,000 children.
Incidence of New Caries over 4 years (% of 1M)	Each time a tooth moved into the decayed state (NSC) was counted. This total was divided by the number of sound teeth at the beginning of the model (NSNC + S).
1M Sealant delivery over 4 years (% of 1M)	Each time a tooth moved into the sealed state (S) was counted. This total was divided by 4,000 to determine the percentage of 1M that received a sealant during the model horizon.
End of Year 3 untreated caries prevalence (% of 1M)	At the end of month 36 the number of teeth in the decayed, unfilled state (NSC) were counted and divided by the 4,000 total teeth in the replication.

Abbreviations: DALY, disability-adjusted life-years; NSC, not sealed with untreated caries; S, sealed; NSNC, not sealed with no caries (i.e., no untreated or filled caries); 1M, first permanent molars.

[a]Centers for Disease Control and Prevention (2019). *Oral Health Surveillance Report: Trends in Dental Caries and Sealants, Tooth Retention, and Edentulism, United States, 1999–2004 to 2011–2016*. Atlanta, GA: Centers for Disease Control and Prevention, US Dept of Health and Human Services.