National Oral Health Conference
THE PREMIER MEETING FOR DENTAL PUBLIC HEALTH

Cost-Effectiveness of School-based Dental Sealant Programs (a DALY approach)

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Background

- Roughly 27% of US children living in poverty have untreated caries
- 90% of caries in a child's permanent teeth occur on the chewing surfaces of molars
- Sealants prevent 81% of potential caries 2 years after placement
  - Remain protective at 9-years after placement

Tooth with Deep Fissures

Dental Sealant used to protect from decay

Increasing the prevalence of sealants is a national health goal

- **OH-12 -** Increase the proportion of children and adolescents who have received dental sealants on their molar teeth

- Has endorsed dental care performance measures aimed at increasing sealant use prevalence in children at elevated risk for tooth decay

- Significant disparities exist
  - 38% of low-income children receive sealants compared to 47% of higher-income children
  - In Georgia, low-income children have to travel over 4 times the distance (17 miles) for preventive services compared to higher income children (4 miles)

School-based sealant programs (SBSPs)

- Typically use portable dental equipment to deliver sealants in schools
- Little or no cost to students
- Programs recommended by the Community Preventative Services Task Force

- *However*, many eligible US schools have no program
  - Only 15 states had programs in more than half of schools where free/reduced lunch program participation was ≥ 50% (target criteria)

Objective

- Estimate caries risk using actual data from children participating in SBSPs
- Estimate net cost for a SBSP to prevent a disability adjusted life-year (DALY) through the use of dental sealants
  - Social perspective allows results to be comparted to results for other interventions

DALY

- Measure of overall disease burden
  - A year in which normal activities are limited, owing to disease, injury, or disability
  - DALY values range from 0 (perfect health) to 1 (death)
- Cost per averted DALY (threshold based on US GDP per capita):

$$\frac{\text{SBSP Cost}-\text{Averted fillings and productivity losses}}{\text{Averted DALYs due to reduced toothahes attributable to SBSP}}$$

Methods

- Estimated net costs and increased quality of life derived from sealing a child's 4 permanent first molars (1Ms)
- Performed sensitivity analysis
- Baseline data from school programs in 14 states (2013-2014)
  - Aged 6-10 years; N=36,753
  - At least 50% of students participated by free/reduced meal program
  - Screened by SBSPs

Followed recommendations of Second Panel on Cost-effectiveness in Health and Medicine (*JAMA* 2016;316(10)1093-1103)

Assumptions

- All caries in permanent teeth occur in pit and fissures of 1Ms
- All 1Ms erupt at age 6
- Annual probability that a 1M develops a caries is constant
- Sealants are effective for 4 years (9 years in sensitivity)
- All four 1Ms are sealed by SBSP (3 in sensitivity analysis)
- All caries occur at the beginning of the year
- A child has caries filled in 1 visit, regardless of number of caries
- Untreated caries in year *i* are filled in year *i*+1

Parameters

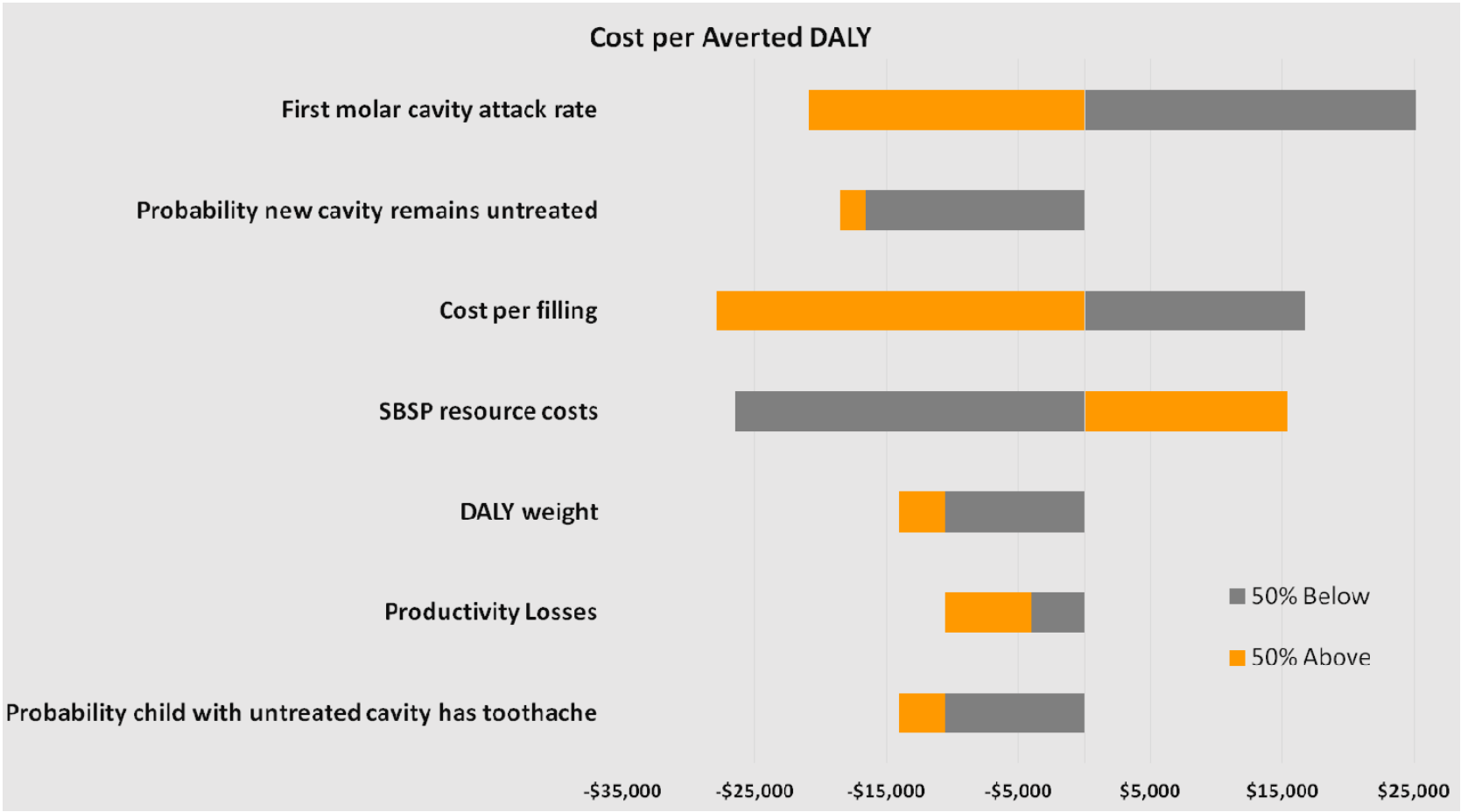
- First-molar caries attack rate (*based on 14 programs*)
- Probability a caries remains untreated (*NHIS data*)
- School-sealant effectiveness at 1, 2, 3, 4 years (*Cochrane*)
- Probability of toothache in child with untreated caries (*National data*)
- Loss in health/well being from toothache; DALY (*Global Burden*)
- SBSP resource costs (*4 US studies*)
- Cost per filling (*National data*)
- Productivity losses (*Time-based*)

Cost-effectiveness per 1000 Children for Different Assumptions (2014 USD)

Assumption	Net cost	Averted years with toothache	Averted DALYs	Net cost per averted DALY
Base	-$8,429.82*	132.60	1.59	NR
9-years	-$23,219.25	175.92	2.11	NR
Sealed 3 teeth	$9,165.08	110.64	1.33	$7,293.30
Filling cost=Medicaid	$27,982.30	132.60	1.59	$18,540.71
No productivity losses	-$4,232.18	132.60	1.59	NR

*Net cost per child was -$8.43; 95% confidence interval: -$10.72 to -$6.14

Effect of Varying Parameters on Cost Effectiveness



Impact of Caries Attack Rate and SBSP Cost on Cost-Effectiveness (2014 USD)

Annual 1st Molar Caries Attack Rate	SBSP Cost per Child						
	$40	$50	$60	$70	$80	$90	$100
0.04	$1,439	$11,485	$21,531	$31,578	$41,624	$51,670	$61,716
0.05	CS	$2,031	$10,515	$18,998	$27,482	$35,965	$44,449
0.06	CS	CS	$2,666	$10,119	$17,572	$25,025	$32,478
0.07	CS	CS	CS	$3,346	$10,072	$16,798	$23,524
0.08	CS	CS	CS	CS	$4,070	$10,259	$16,448
0.09	CS	CS	CS	CS	CS	$4,841	$10,619
0.10	CS	CS	CS	CS	CS	$203	$5,658
0.11	CS	CS	CS	CS	CS	CS	$1,327
0.12	CS	CS	CS	CS	CS	CS	CS

Base Case: attack rate = 0.077; Mean SBSP cost = $63.33

Conclusions

- Under almost all tested scenarios, SBSPs met the cost-effectiveness threshold
- Combining the threshold with our sensitivity analysis provides decision makers with a way to compare investing in SBSPs to other competing alternatives

Providing sealants in SBSP to 1,000 children would prevent toothaches for a year in 133 children and 1.59 DALYs (3.04 DALYs using Kassebaum et al. (2017)).

Limitations

- Estimates of averted treatment costs and productivity losses were conservative
- We may have overestimated the loss of quality of life associated with untreated 1M caries if the impact of these teeth produced no additional discomfort in the presence of other teeth with untreated caries
- Comparison group was children not receiving sealants, as opposed to children in a school without a SBSP

How can we increase SBSP coverage?

- Increase Medicaid reimbursements
- Bundle sealant delivery with other services
- Allow dental hygienists to practice at the top of their license
- Increase oral health literacy among stakeholders and recipients
  - Consent forms

- Variety of recommendations outlined at the CDC Vital Signs (also next session at 1:15pm with Crespin, Koppelman, and Lowe)

CDC Vitalsigns™

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S. Griffin et al., *Health Affairs*, 2016; 35(12): pp. 2233-2240.

Estimating 1st molar attack rate

- Estimate cumulative probability a 1M developed a cavity by summing increment by year of age and divide sum by total number of 1M (4*# children)
- Subtract cumulative probability from 1 to get cumulative probability that a 1M did not develop a cavity
- Annual probability a 1M is sound is obtained by taking nth root of cumulative probability of sound 1M (n=age-6)
- Subtract this value from 1 to get 1M attack rate for each group

Exhibit A1: Annual 1M attack rate for children with no sealants at baseline screening prior to sealant placement by age: SSPs in 14 states[a], 2013-2014

AGE	Number screened	Mean	SE	Median
7	15676	0.089	0.009	0.089
8	11450	0.073	0.007	0.069
9	5318	0.067	0.007	0.070
10	4310	0.065	0.008	0.061
Weighted across age groups	36753	0.078	0.007	0.077

[a]Estimated from data collected at baseline screening by school-based sealant programs in Connecticut, Georgia, Iowa, Kansas, Louisiana, Maryland, Minnesota, Mississippi, New York, North Dakota, Rhode Island, South Carolina, West Virginia, and Wisconsin.

Probability a new cavity remains untreated

- Used National Health Interview Survey (NHIS) Supplement on whether a child had received treatment for a dental problem
  - Urgent (cavity, toothache, broken/missing tooth or restoration and bleeding gums)
  - Non0urgent (stained, crooked, or loose teeth; dry mouth, jaw pain, moth sores, bad breath)
- Subtracted estimated probability of visiting the dentist among low income (<100%FPL) children for a reported urgent problem, 0.53 (se=0.03) from 1 to estimate probability untreated.

School sealant effectiveness

- Converted odds ratio in Cochrane review to relative risk ratios (RR=OR/(1M Attack Rate*(1+OR))
- Relative risk ratios were adjusted upward (multiplied by 3.2) such that the overall 4-year effectiveness would be 50% (estimate from Task Force Systematic Review)
- Percent reduction in incidence and increment due to sealants for 1, 2, 3, and 4, years were 68.5%, 57.9%, 40.1%, and 25.8%

Probability a child with untreated cavity has a toothache

- Used published estimates from national survey data on the ratio of percentage of 6-17 year olds in 2007 with a reported toothache within the last 6 months (12%) to the percentage of 5 to 19 year olds in 2005 to 2008 with at least one untreated cavity (16.6%) to estimate the probability that a child with at least 1 untreated cavity would experience pain.

Loss in health/well being

- Used DALY data from the Global Burden of Disease
- Note that this only included the effect of morbidity (toothache due to untreated caries) on quality of life.

SBSP Cost

- Used finding from the systematic review of economic analysis conducted for the Task Force

Cost per filling

- Used information from the ADA surveys on average fee for pediatric dentists and relative frequency of placing one and two surface fillings.
- Existing guidance recommends using average provide reimbursements instead of public insurance reimbursements.
- To be conservative, we estimated the % of total charges that insurance companies reimburse using Fair Health calculator (detailed sampling found reimbursed at 80% of charge. ($139.18)
- For Medicaid, we assumed only single surface fillings from the 14 states that provided data ($64.17)

Productivity losses

- Assumed child would visit dentist once.
- National data showed a typical trip of 1.5 hours, and total hourly value of household services was $14.23. So total loss was $21.34.