Blue Sky CONSULTING GROUP

THE BENEFITS OF PREVENTIVE DENTAL CARE

Estimating the Fiscal Impact of the Virtual Dental Home Project

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Contents

EXECUTIVE SUMMARY

The Pacific Center for Special Care, University of the Pacific Arthur A. Dugoni School of Dentistry's Virtual Dental Home Demonstration Project offers the potential for an innovative, low cost method to improve access to dental care for vulnerable populations in California. The project has created a "virtual dental home" for patients who might not otherwise be able to access care in a traditional dental office. The Virtual Dental Home provides prevention-focused oral health services in community sites such as Head Start Centers, schools, residential living facilities for people with disabilities, and long-term care institutions for dependent or elderly adults. In these community settings, dental hygienists and dental assistants will provide the preventive and temporizing restorative treatments that are recommended by dentists connected via telehealth technology. Overall, the project seeks to provide treatments that are based on each individual patient's risk-level and needs.

While the primary goal of the project is to improve access to dental care through a "virtual dental home," and, in so doing, improve oral health for its patients, the cost-effectiveness of the program's interventions has not previously been measured. In this report, we present information about the effects of the preventive procedures emphasized in this model of care and the results of a simulation model that estimates the potential cost impact of the Virtual Dental Home project on the Medi-Cal program.

In order to understand the health benefits and to estimate the fiscal effects of the Virtual Dental Home project, we developed a simulation model that utilized published research to establish the clinical effectiveness of various dental care interventions, and then applied California-specific costs for the Medi-Cal program to arrive at an overall estimated fiscal impact specific to California. To create this model, we first reviewed published research on the effectiveness and cost-effectiveness of preventive dental care for patient populations similar to those served by the Virtual Dental Home project. This literature review revealed that preventive care has been shown to be effective in improving oral health. However, there is less data available about the fiscal impacts (i.e., cost-effectiveness) of this care. In addition, research on specific preventive services can be difficult to interpret because it often includes the impact of Medicaid's low utilization rate for dental care services and relatively low provider reimbursement rates, as well as the impact of improved access to care. Nevertheless, we identified multiple relevant studies that provided the input assumptions for our modeling effort.

Because the impact of dental care varies by patient risk level, which changes with age and disability status, we organized the population being served by the project into four categories: the elderly residing in skilled nursing facilities (SNFs), developmentally disabled adults living in intermediate care facilities (ICFs) or served by a Department of Developmental Services regional center, children age 6 to 18 that are attending school, and children under 6 that attend Head Start. For each population, we modeled the impact of several dental care services similar to those provided by the Virtual Dental

Home project. For each intervention, we identified relevant estimates of the impact on patient outcomes and then applied these findings to California-specific cost estimates.[1]

Our model of preventive care and potential cost outcomes shows that ongoing and targeted preventive dental care could save Medi-Cal $0.20 per patient visit in a skilled nursing facility, $18 per disabled adult visit, and $2 per Head Start patient visit. In addition, our modeling suggests that preventive services for school-aged children return a majority of Medi-Cal expenditures in future benefits even though they do not produce a short-term overall savings per patient, but instead would result in a net cost of $36per patient visit.[2] These per patient visit figures can equal significant savings when applied to the many patients seen every year by the Virtual Dental Home.

These cost findings are driven by the availability of published research and the design of the model for adults and school-aged children. For example, our model utilizes studies on the effectiveness of individual preventive services (e.g., application of a fluoride varnish or sealant). There are not enough studies in the literature to draw conclusions about the effectiveness of preventive care generally (or to base model results on such a finding). In studies of particular preventive services, researchers tend not look at the costs and benefits of the exam or the overall preventive services program, but instead look at the cost and outcome of the specific preventive service being studied (e.g. fluoride varnish application). As such, an exam is simply an additional cost for which no direct benefits are estimated and our model ascribes costs to these services, but no benefits. Yet, the visit itself may provide benefits in the form of patient and parent education and a way to establish better oral health behavior. In other cases in which specific published findings were not available, we used research-based assumptions to model the effects of preventive care. Therefore the conclusions in this report are limited by the availability of relevant studies. It is possible that future research could, for example, establish a link between increased access to preventive care generally and improved oral health. In that case, the results presented here should be refined. In addition, the results presented here are based on the current Medi-Cal reimbursement system for providers. It is possible that an alternative system that aligned provider payments with health outcomes would have a different result.

Finally, it is important to note that the results presented here examine just one part of the impact of the Virtual Dental Home project – the estimated fiscal impact for the Medi-Cal program. Our results do not reflect the impact of reduced pain and suffering which may result from increased access to dental care, nor do they reflect the benefits of reduced days missed from school or work or increases in employability, socialization, nutrition, and self-esteem which may result from improved oral health.

In general, our review of the published research supports the conclusion that preventive dental procedures are effective, particularly if they are available on an ongoing basis and targeted to

[1] In a handful of cases, we were able to identify cost-effectiveness studies (as opposed to studies that looked only at clinical effectiveness). In these cases we adapted the cost effectiveness findings to reflect the impact on a California Medi-Cal population.

[2] Note that these results are presented on a per visit basis, but assume that patients receive ongoing dental care as part of their participation in the virtual dental home program.

populations at risk for dental disease, which is the goal of the Virtual Dental Home model of care. In addition, our results suggest that in most of the populations modeled, the health benefits of improved access to preventive dental care could be realized while simultaneously producing savings for the Medi-Cal program. Even with school-age children, where the results indicate a small cost to the state, the health benefits of improved access to preventive dental care could be realized at a relatively modest cost.

INTRODUCTION

Low-income populations in California can experience significant barriers in seeking to access dental care: high cost, few providers, impaired mobility, cultural barriers, and special medical needs. The Virtual Dental Home project is an effort to address these barriers and help fill unmet need for dental care among these populations by providing dental care in community locations such as schools, nursing homes, and Head Start centers.

While the primary goal of the project is to improve clinical outcomes for its patients by improving oral health and preventing or relieving pain and suffering, the cost-effectiveness of the project's interventions has not previously been studied. Specifically, the analysis presented in this report seeks to shed light on the question of the extent to which the Virtual Dental Home project can be both effective in improving health outcomes for vulnerable populations and also decrease costs for the state's Medi-Cal program?

THE VIRTUAL DENTAL HOME AND MEDI-CAL

The Virtual Dental Home is a four-year pilot project operated by the Pacific Center for Special Care at the University of the Pacific Arthur A. Dugoni School of Dentistry. The project provides prevention-focused oral health services in community sites such as Head Start centers, schools, residential living facilities for people with disabilities, and long-term care institutions for dependent adults and elderly individuals. These services seek to reach children and adults that face significant barriers to accessing care in the traditional delivery system. The telehealth system used in the Virtual Dental Home gives participating dentists the technological capability to review patients' dental records remotely and then recommend a plan for providing care while dental hygienists and dental assistants perform preventive and temporizing restorative treatments for patients in the community setting. The type of services provided to patients is based on risk assessments, which target preventive services, such as sealants and fluoride, to patients that are at higher risk for future decay. For patients that need further treatment, the project seeks to help establish a relationship with a dentist's office or clinic which can provide additional treatment.

While not all low-income Virtual Dental Home patients are Medi-Cal beneficiaries, many are. Many low-income children, pregnant women, parents, and aged, blind, or disabled adults are eligible for Medi-Cal. However, not all of these Medi-Cal patients will receive care. This is because preventive dental care is currently only available to adults living in institutionalized settings or served by a Department of Developmental Services regional center, to pregnant women, and to children. For all other Medi-Cal beneficiaries, only limited emergency dental services are covered. Although Medi-Cal may benefit from reduced emergency dental care and medical costs resulting from better oral health for these populations, in this report we investigate the potential cost impact of providing preventive dental services to those for whom Medi-Cal may be billed: low-income children in schools, young

children in Head Start programs, disabled and elderly adults in skilled nursing facilities (SNFs) and intermediate care facilities (ICFs) or disabled adults served by regional centers.

STUDY METHODOLOGY

In order to understand and model any potential cost savings from the Virtual Dental Home, the study team brought together a group of dental experts to provide insight on the impact and potential cost-effectiveness of preventive dental care. This project advisory group was created in cooperation with Dr. Paul Glassman, Principal Investigator of the Virtual Dental Home project. A list of participants is provided in Appendix A. The efforts of this group of scholars and practitioners as well as additional research efforts by the study team produced a compendium of almost 150 published studies, which were closely reviewed and synthesized in order to understand if and when providing preventive care to the project's patient populations could provide cost savings for Medi-Cal.

This report reviews the state of the literature on the effectiveness and cost-effectiveness of preventive dental care, outlines the model used to estimate the potential savings from the Virtual Dental Home project, and then presents estimates of the fiscal impact of the project on the Medi-Cal program.

Preventive Dental Care is Effective

A large body of published research literature on preventive dental visits and services demonstrates that this proactive care is generally effective in reducing disease and decay and improving oral health, both for children and adults.

Most of the research on prevention is centered on specific services, but investigations into preventive care more generally have also been conducted. One such preventive care program (which is similar to the Virtual Dental Home project in terms of the goal of increasing access to preventive care for under-served children) is called the Access to Baby and Child Dentistry (ABCD) program. The most recent study of the program's effectiveness found that children in a county with the program had more sound teeth, fewer crowned teeth, and fewer missing primary teeth than did children in a county without the program.[3] An earlier study also found that Medicaid-enrolled children not in the program had, on average, 45 percent more teeth with initial lesions.[4]

Research into the effectiveness of preventive care generally is more limited for other populations. However, a recent examination of the length of time between dentist visits in adults found that patients with 1 year or longer periods between visits had worse outcomes relative to patients who were seen more frequently. As the length of time between visits increased, the need for dental intervention increased, as did plaque, calculus and staining. For Medicaid patients in particular, the study found that

[3] Michelle Kobayashi et al., "The Effectiveness and Estimated Costs of the Access to Baby and Child Dentistry Program in Washington State," *Journal of the American Dental Association (1939)* 136, no. 9 (September 2005): 1257–1263.
[4] Tarja Kaakko et al., "An ABCD Program to Increase Access to Dental Care for Children Enrolled in Medicaid in a Rural County," *Journal of Public Health Dentistry* 62, no. 1 (2002): 45–50, doi:10.1111/j.1752-7325.2002.tb03420.x.

more frequent visits led to improved oral health outcomes.[5] In addition, a meta-analysis on the impact of routine dental checks, which sought to detect the best recall frequency for the average patient, reported that there was a preponderance of studies reporting that less frequent dental checks lead to an increase in decay, a decrease in the number of teeth, and a decrease in fillings in permanent teeth.[6]

Studies that evaluated the effectiveness of specific preventive procedures (as opposed to preventive care generally) were more common. A meta-analysis of seven studies on sealants found that caries reductions ranged from 87 percent at 12 months to 60 percent at 48-54 months to 50 percent at 9 years, relative to those that had not received sealants.[7] Moreover, a review of the literature on sealants conducted by the Centers for Disease Control and Prevention (CDC), led the CDC to recommend the use of sealants in school-based dental care program.[8] A meta-analysis of 133 studies on topical fluoride applications, which include fluoride toothpaste, mouth rinses, gels and varnishes, found that topical fluorides have been firmly established as beneficial in preventing decay in children aged 5 to 16 years.[9] A meta-analysis of seven fluoride varnish studies found that the practice substantially reduces tooth decay in children's permanent and deciduous (i.e., "baby") teeth.[10] A systematic review of the relatively scarce literature on the impact of fluoride on adults found that exposure to any mode of fluoride reduced cavities by 25 percent.[11]

Several studies also examined the link between preventive dental care and patient health generally. For example, scaling and root planing, which are used to prevent periodontal disease, have been increasingly identified as an effective mechanism to help control diabetes in adults. A meta-analysis of three studies found that scaling and root planing produce a small but significant effect in reducing HbA1c levels, an important measure of health for diabetics.[12] In addition, scaling and root planing are associated with a decreased risk for future cardiovascular events and decreased risk of chronic

[5] Timothy M. Durham et al., "Oral Health Outcomes in an Adult Dental Population: The Impact of Payment Systems," *Special Care in Dentistry* 29, no. 5 (September/October 2009): 191–197, doi:10.1111/j.1754-4505.2009.00095.x.
[6] C Davenport et al., "The Clinical Effectiveness and Cost-effectiveness of Routine Dental Checks: a Systematic Review and Economic Evaluation," *Health Technology Assessment (Winchester, England)* 7, no. 7 (2003): iii–v, 1–127.
[7] Anneli Ahovuo-Saloranta et al., "Pit and Fissure Sealants for Preventing Dental Decay in the Permanent Teeth of Children and Adolescents," *Cochrane Database of Systematic Reviews (Online)* no. 4 (2008): CD001830, doi:10.1002/14651858.CD001830.pub3.
[8] Barbara F. Gooch et al., "Preventing Dental Caries Through School-Based Sealant Programs Updated Recommendations and Reviews of Evidence," *The Journal of the American Dental Association* 140, no. 11 (November 1, 2009): 1356–1365.
[9] V C C Marinho et al., "Topical Fluoride (toothpastes, Mouthrinses, Gels or Varnishes) for Preventing Dental Caries in Children and Adolescents," *Cochrane Database of Systematic Reviews (Online)* no. 4 (2003): CD002782, doi:10.1002/14651858.CD002782.
[10] Valeria CC Marinho et al., "Fluoride Varnishes for Preventing Dental Caries in Children and Adolescents," in *Cochrane Database of Systematic Reviews* (John Wiley & Sons, Ltd, 2002),.
[11] S O Griffin et al., "Effectiveness of Fluoride in Preventing Caries in Adults," *Journal of Dental Research* 86, no. 5 (May 2007): 410–415.
[12] Terry C Simpson et al., "Treatment of Periodontal Disease for Glycaemic Control in People with Diabetes," *Cochrane Database of Systematic Reviews (Online)* no. 5 (2010): CD004714, doi:10.1002/14651858.CD004714.pub2.

obstructive pulmonary disease, although the evidence of improved health outcomes is not as strong as that found for diabetes.[13]

Is Preventive Dental Care Cost-Effective?

Although preventive care generally produces better health outcomes, the monetary benefits of fewer fillings, crowns, extractions, and follow-on health care costs (i.e., cost-effectiveness) is a separate, and less well studied, research question. In this section, we review cost-effectiveness and cost-benefit studies for both children and adults before further exploring their implications in the next section.

Studies on Children

For children, the literature on the impact of preventive dental care on costs generally revolved around two specific services: fluoride varnish and sealants.[14] The results of these studies were mixed, and depended on the dental care costs, the population's risk for dental problems, and the population's likelihood of using dental services.

Preventive Visits

We reviewed five studies that looked at the effect of preventive visits on dental outcomes and costs for children. Two of them looked at the effect of a preventive program on overall Medicaid costs, another two studies examined the impact of preventive visits on Medicaid costs for individual patients, while a fifth study measured the impact of a preventive program on Medicaid costs for individual patients.

First, Kobayashi et. al. estimated the effectiveness of the Access to Baby and Child Dentistry (ABCD) program, which seeks to expand access to preventive dental care services for young children on Medicaid. This research found that, by 3rd grade, children in a county with the program had better oral health than did children in a non-participating county.[15] However, the authors also found that the county in which the ABCD program was in place experienced per capita dental costs that were $8 higher. Unfortunately, the study did not directly compare the costs of children enrolled in ABCD to those who were not enrolled, so it is unclear if these additional costs are related solely to the preventive program. Another reviewer of the same program found that the annual dental care expenditures were $14.88 greater for ABCD children during the first year, but were $11.09 lower over the entire 2.5 year period. [16] This study employed a randomized control design and could measure precisely the effect of the program on average cost per child. However, it only followed the children for

[13] Zu-Yin Chen et al., "The Association of Tooth Scaling and Decreased Cardiovascular Disease: a Nationwide Population-based Study," *The American Journal of Medicine* 125, no. 6 (June 2012): 568–575, doi:10.1016/j.amjmed.2011.10.034; Zuomin Wang et al., "Periodontal Health, Oral Health Behaviours, and Chronic Obstructive Pulmonary Disease," *Journal of Clinical Periodontology* 36, no. 9 (September 2009): 750–755, doi:10.1111/j.1600-051X.2009.01448.x.

[14] Although other topical fluoride applications that are professionally applied such as gels were shown to be effective, we did not encounter any cost benefit studies on them.

[15] Kobayashi et al., "The Effectiveness and Estimated Costs of the Access to Baby and Child Dentistry Program in Washington State."

[16] Kaakko et al., "An ABCD Program to Increase Access to Dental Care for Children Enrolled in Medicaid in a Rural County."

2.5 years and did not address the issue of whether increased access to care resulted in increased Medicaid costs.

Second, Savage et. al. investigated the impact of the timing of preventive visits on overall dental costs for children under 6.[17] This investigation studied North Carolina children who were enrolled continuously in Medicaid from birth for a 5-year period. They found that children who had their first preventive dental visit by age 1 were more likely to have subsequent preventive visits but were not more likely to have subsequent restorative or emergency visits. In addition, the age at the first preventive dental visit had a significant positive effect on dental expenditures, with the average dental costs being less for children who received earlier preventive care. A follow-up article on the same topic provided additional cost findings. These researchers found that children at highest risk of dental disease who received a preventive visit before the age of 18 months had lower dental costs between the ages of 3.5 and 6 years relative to those who waited to receive a dental visit until the age of 18 months to 3 years. However, the research also suggested that a visit before age 3 for most children was not associated with lower dental costs.[18]

Finally, a study of a preventive program for children under the age of three, called Into the Mouths of Babes (IMB), was able to measure the impact of increased preventive dental care on children in the program. In this study, Stearns et. al. looked at the effectiveness of early childhood visits at medical offices, which included screening, parental counseling, fluoride varnish, and referral to dentists when needed. The authors found that children receiving four or more program visits had a lower likelihood of having dental caries related treatment in a hospital or dentist office relative to those with no visits.[19] Similar to the findings of Savage et. al., the program increased the likelihood of preventive and diagnostic visits after the age of 3, but reduced the likelihood of having a hospital episode. However, the program was not cost saving when taking into account the entire cost of the visit; on average, visits saved $231 per person, but cost $242 per person.

Thus, the literature on preventive visits suggests that increasing access to preventive dental care can decrease the need for restorative visits, and the resulting savings can make overall dental care costs decrease. However, it is also clear from the mixed nature of the findings that targeting preventive care is very important from a fiscal standpoint, and that access to care is most beneficial for patients that are at high risk for decay.

[17] Matthew F Savage et. al.., "Early Preventive Dental Visits: Effects on Subsequent Utilization and Costs," *Pediatrics* 114, no. 4 (October 2004): e418–423.
[18] Heather Beil et al., "Effect of Early Preventive Dental Visits on Subsequent Dental Treatment and Expenditures," *Medical Care* (April 19, 2012), doi:10.1097/MLR.0b013e3182551713.
[19] Sally C. Stearns, "Cost-effectiveness of Preventive Oral Health Care in Medical Offices for Young Medicaid Enrollees<alt-title>Cost-effectiveness of Preventive Oral Health Care</alt-title>," *Archives of Pediatrics & Adolescent Medicine* (August 27, 2012): 1, doi:10.1001/archpediatrics.2012.797.

Fluoride Varnish

Studies of fluoride varnish use for children generally found that fluoride was effective in reducing tooth decay, but was not generally cost-effective in terms of lowering overall dental care costs. For example, Quinonez et. al. built a model of the cost-effectiveness of fluoride varnish at well-child doctor's visits and found that restorative treatment costs were reduced by $52, but this did not offset the $64 cost of the four applications of fluoride varnish.[20] Hirsch et. al. estimated the 10-year intervention costs and restorative benefits for several preventive measures including fluoride varnish for Colorado children.[21] They found that fluoride varnish would save $34 million when applied to high-risk children over 6 months, but cost $56 million to implement.

Sealants

Three studies utilized Medicaid claims data for children to estimate the effect of sealants on costs related to the sealed teeth. All three suggest that sealants are clinically effective, but not necessarily cost-effective. Bhuridej et. al. assessed the 4-year incremental cost utility of sealing first permanent molars of 6-year-old Iowa Medicaid enrollees. The study found that sealed molars incurred higher costs than non-sealed molars, both overall and in each year studied even though they were 10 percent less likely to receive a restorative treatment.[22] While the findings from this study are influenced by the fairly short time frame within which benefits would have had to accrue, studies with longer time frames find costs as well. An 8-year retrospective cohort study of Medicaid children by Weintraub et. al. found that children who do not receive sealants were more likely to obtain subsequent restorative care and to cost more money. However, when sealant costs were taken into account, the program resulted in net cost increases. The savings to the Medicaid program for placing sealants in high-risk children were not sufficient to offset the cost of placing sealants in first permanent molars of all Medicaid-eligible children who received them.[23] This is because two-thirds of the children did not receive caries-related services paid for by Medicaid during their time enrolled. The authors do note, however, that the low utilization rates among North Carolina Medicaid children may result in an underestimate of the real benefits of sealants. Finally, a retrospective cohort study of 5- to 7-year-olds with Medicaid found that children with sealants had 70 percent of the dental costs of children without sealants during a 7 year study period.[24] Specifically, approximately 10 percent of the sealant group had subsequent restorative care in terms of posterior 1-surface amalgam or resin restorations, and about 33 percent of the non-sealant group had similar services. The author reported cost savings, saying sealants would have

[20] Rocio B Quiñonez et. al.., "Simulating Cost-effectiveness of Fluoride Varnish During Well-child Visits for Medicaid-enrolled Children," *Archives of Pediatrics & Adolescent Medicine* 160, no. 2 (February 2006): 164–170.
[21] Gb Hirsch et. al.., "A Simulation Model for Designing Effective Interventions in Early Childhood Caries," *Preventing Chronic Disease* (March 2012), http://www.cdc.gov.libproxy.usc.edu/pcd/issues/2012/11_0219.htm#table1_down.
[22] Patita Bhuridej et. al.., "Four-year Cost-utility Analyses of Sealed and Nonsealed First Permanent Molars in Iowa Medicaid-enrolled Children," *Journal of Public Health Dentistry* 67, no. 4 (2007): 191–198.
[23] J A Weintraub et. al.., "Treatment Outcomes and Costs of Dental Sealants Among Children Enrolled in Medicaid," *American Journal of Public Health* 91, no. 11 (November 2001): 1877–1881.
[24] Ananda P Dasanayake et. al.., "Restorative Cost Savings Related to Dental Sealants in Alabama Medicaid Children," *Pediatric Dentistry* 25, no. 6 (December 2003): 572–576.

resulted in about $16 of savings to Medicaid in subsequent restorative costs per child had they received prior sealants. However, when taking into account the sealant costs for those children that had no follow-up dental care (89 percent), the sealant program was $3 more expensive per child.

Although the Medicaid claims studies did not report cost savings from sealant use, two model-based studies did find savings from sealants. A cost-effectiveness analysis by Zabos et. al. of a school-based dental sealant program for low-income children estimated that over a 5 year period, costs of care for the group given dental sealants were almost 20 percent lower than for the control group.[25] Similarly, a Markov model of three different sealant strategies built by Quinonez et. al. found that over a 10 year period the seal-none strategy cost $13.50 and $14.30 per tooth more than seal-all and risk-based strategies, respectively.[26] The study provided evidence that sealing children's first permanent molars can "improve outcomes and save money by delaying or avoiding invasive treatment and the destructive cycle of caries" even though it only measured the effect of sealants on fillings and assumed that all subsequent, needed restorative treatment would be utilized.

Summary

For young children, research suggests that preventive visits can be cost-saving in the long-run when targeted to high-risk users. However, a preventive program with a less targeted approach had mixed results. No studies on the cost outcomes of preventive programs were found for school-aged children. Cost outcomes for two preventive services, fluoride and sealants, were not always positive, even though health outcomes were objectively better. In fact, fluoride studies that took into account the full range of follow-up dental treatment, found that fluoride varnish programs were more costly. These results were almost exclusively for young children, leaving little evidence of the cost outcome of fluoride for older, school-aged children. For sealants, which are applied to school-aged children, studies that relied on the actual claims experience of low-income populations found that sealing molars for the Medicaid population would cost more than it saves in reduced filling expenditures because the average child was unlikely to seek treatment for decay. When sealants were targeted to high-risk children or when decayed teeth were restored instead of ignored, then sealants saved money.

Studies on Adults

Cost-effectiveness studies for adults were scarcer. We identified two studies that looked at the impact of preventive care on dental costs. An individual patient-simulation Markov model was developed by Warren et. al. to compare the long-term costs and outcomes of regular maintenance through the Caries Management System versus standard dental care in a hypothetical sample representative of the

[25] Georgina P Zabos et al., "Cost-effectiveness Analysis of a School-based Dental Sealant Program for Low-socioeconomic-status Children: a Practice-based Report," *Journal of Health Care for the Poor and Underserved* 13, no. 1 (February 2002): 38–48.

[26] Rocio B. Quiñonez et. al.., "Assessing Cost-Effectiveness of Sealant Placement in Children," *Journal of Public Health Dentistry* 65, no. 2 (2005): 82–89.

Australian population.[27] They found that the more proactive system is most cost-effective in patients with a high risk of dental caries. In a study of the Medicare population, Moeller et. al. found that beneficiaries who used preventive dental care had more dental visits but fewer visits for expensive non-preventive procedures and lower dental expenses than beneficiaries who saw the dentist only for treatment of oral problems.[28] Getting preventive care instead of non-preventive care would have saved $216 per capita. Although this analysis did not account for the majority of beneficiaries that did not see a dentist during the year, the authors believe it is evidence that adding dental coverage for preventive care could pay off in terms of both improving oral health and limiting the costs of expensive non-preventive dental care.

Several studies looked at the impact of preventive dental care on medical costs. An analysis of Blue Care Network claims data by Taylor et. al. found that for diabetic patients with an average of 1 to 2 non-surgical periodontal and prophylaxis procedures in a year, total per member per month (PMPM) health care costs were 11 percent lower, diabetes-related PMPM costs were 14 percent lower, and emergency room expenditures were 22 percent lower relative to those without periodontal and prophylaxis procedures.[29] Another study by Albert et. al. examined a PPO insurance database to see if periodontal treatment could contribute to changes in overall risk and medical expenditures for three chronic conditions: diabetes, coronary artery disease, and cerebrovascular disease. Their analysis found that patients with dental maintenance services had lower PMPM medical costs than those with periodontitis and gingivitis services, but higher than those without any services. A similar analysis of Maine's all-insurer database by Ladenheim et. al. found that patients with cardiovascular disease and one periodontal visit in the year had 4 percent lower overall medical costs than those without a visit.[30] Finally, although it does not capture the effect of a specific type of preventive visit, a Japanese study of periodontitis found that subjects with severe periodontitis accrued 21 percent higher inpatient, outpatient, and dental costs compared to those with no pathological pocket over the 3.5-year study period.[31]

[27] Emma Warren et al., "Modeling the Long-term Cost-effectiveness of the Caries Management System in an Australian Population," *Value in Health: The Journal of the International Society for Pharmacoeconomics and Outcomes Research* 13, no. 6 (October 2010): 750–760.

[28] John F Moeller, Haiyan Chen, and Richard J Manski, "Investing in Preventive Dental Care for the Medicare Population: a Preliminary Analysis," *American Journal of Public Health* 100, no. 11 (November 2010): 2262–2269.

[29] George W Taylor et al., *Is Periodontal Treatment Associated with Lower Medical Costs in Adults with Diabetes? Findings in Blue Care Network 2001-2005*, January 2009.

[30] Kala E Ladenheim, Margaret I Gradie, and Kathleen E Perkins, "Demonstrating the Oral-systemic Link for Cardiovascular Disease in Maine: Strong Association Found Between Spending and Periodontal Care," in *Oral-Systemic Health Linkages and the Impact of Behavior* (presented at the American Public Health Association Oral Health Section Annual Conference, Washington, D.C., 2011).

[31] Reiko Ide, Tsutomu Hoshuyama, and Ken Takahashi, "The Effect of Periodontal Disease on Medical and Dental Costs in a Middle-aged Japanese Population: a Longitudinal Worksite Study," *Journal of Periodontology* 78, no. 11 (November 2007): 2120–2126.

Considerations in Interpreting the Literature

According to the published research literature, preventive services are effective in preventing decay and disease. In addition, many advocates and practitioners have observed health, educational, social, and societal benefits. However, these preventive procedures are not always effective in reducing costs. For children, studies of Medicaid populations find that costs do not always decrease for several reasons, although the two primary factors are (a) the restorative care is not very costly for the program compared to the preventive measures and (b) many patients do not come in for needed restorative care even if it would be covered by Medicaid. In other words, the studies are capturing not only the impact of preventive services, but the realities of the Medicaid program's poor utilization and reimbursement rates.

This basic fact, that those who need care may not be showing up to get care, is characteristic of California as well. For example, only 29 percent of eligible beneficiaries under age 5 and 44 percent of beneficiaries between 6 and 20 used dental services in 2009-10.[32] Yet, California ranks near last in the nation in terms of children's oral health status, with approximately 66 percent of third graders in poor oral health.[33] Nationally, an estimated one in three children enrolled in Medicaid has untreated tooth decay, and one in nine has untreated tooth decay in three or more teeth.[34] This pattern is acknowledged in many of the cost-effective studies. For example, a review of a school-based dental sealant program in New York found that 66 percent of the control group and 78 percent of the sealant group had untreated carious lesions upon follow-up examination.[35] Similar concerns about low utilization prompted researchers to note that savings from treatment could be underestimated in their studies. If children who have dental problems do not show up to have them fixed, studies will capture the costs of preventive services and but not the offsetting savings.

Another methodological reason that studies may not find cost savings, even if they exist, relates to the time horizon over which researchers can observe results. Research is generally limited to a period of a few years at most, even though the benefits of prevention (or the costs of neglect) may accrue over a longer period of time.

In spite of the lack of a consensus among researchers as to the cost-effectiveness of preventive care, especially for school-age children, research does suggest that preventive care is highly effective, that it can be cost-effective for young children, and that it can reduce health care costs for certain adult populations.

[32] Data provided by Lisa Simonson Maiuro, MSPH, Ph.D. of Health Management Associates (HMA), as part of a CHCF funded project to examine the impact of cuts in adult Medi-Cal dental services. Data were extracted from the Medi-Cal MIS/DSS and summary data were obtained from a performance measurement dashboard created by Dr. Maiuro and HMA.
[33] "Facts & Figures: Oral Health" (Children Now, 2012), http://www.childrennow.org/index.php/learn/facts_oral_health.
[34] Ibid.
[35] Zabos et al., "Cost-effectiveness Analysis of a School-based Dental Sealant Program for Low-socioeconomic-status Children."

MODELING THE IMPACT OF PREVENTIVE DENTAL CARE

In order to model the fiscal impact on Medi-Cal of the Virtual Dental Home project, we developed a simulation model that relies on the published research literature to establish the clinical effectiveness of various dental care interventions, and then applies California-specific costs for the Medi-Cal program to arrive at an overall estimated fiscal impact. Because our model relied on published research, we were not able to capture all potential cost impacts, but only those with enough reliable work available in the published literature. In cases in which no published studies were available, we developed input assumptions based on research findings and our own analysis. Figure 1 (next page) presents a schematic of the simulation model we developed.

Because the impact of dental care varies by patient risk level, which changes with age and disability status, we first organized the population being served by the project into four categories: the elderly residing in skilled nursing facilities (SNFs), developmentally disabled adults living in intermediate care facilities (ICFs) or receiving services through regional centers, children age 6 to 18 that are attending school, and children under 6 that attend Head Start.

For adults, our model sought to estimate the fiscal effects of two dental services offered by the Virtual Dental Home project: fluoride applications and preventive periodontal treatments. Fluoride applications have the potential to reduce restorative dental costs, while preventive periodontal treatments have been shown to reduce overall medical costs for patients with diabetes.[36] For school-aged children, we estimated the fiscal effects of two dental services: sealants and fluoride varnish. For Head Start children, published research allowed us to model the impact of preventive visits generally.

For each intervention, we identified relevant estimates of the impact of this care on costs or cost-producing (i.e., clinical) outcomes. Then we applied these findings to California-specific cost estimates. For other interventions provided by the mobile clinic such as dental exams, patient education, and interim therapeutic restorations, we included the cost of these interventions, but no follow-on health or dental care cost savings. [37]

It should be noted that many of the benefits of dental care come from ongoing access to preventive care and not from *one* preventive visit. The results presented in this report, therefore, incorporate the assumption that the Virtual Dental Home project provides access to ongoing care. In presenting our

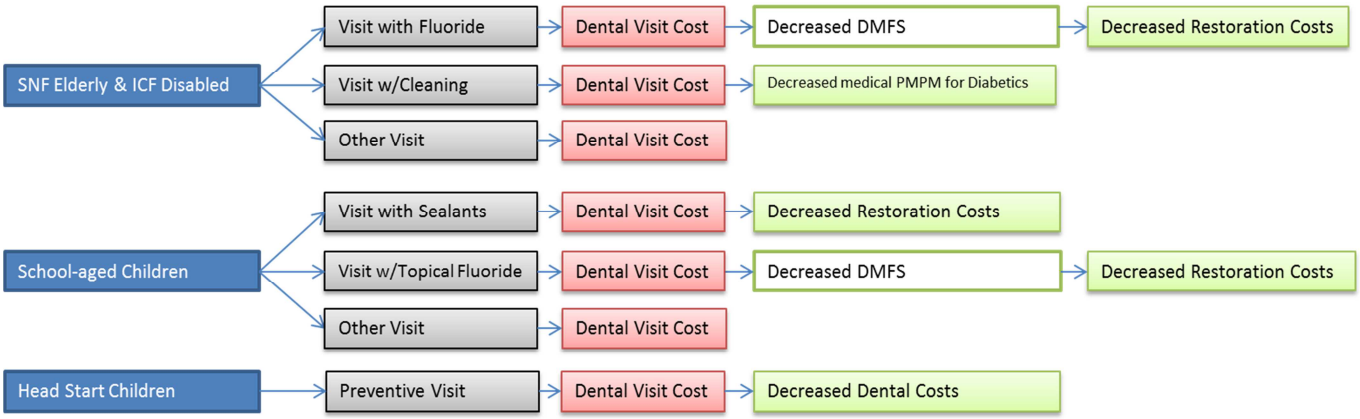
[36] Studies have shown cost savings for other chronic disease patients including those with heart disease. However, because the American Heart Association has specifically stated that it does not believe the literature has yet proved a causal relationship between dental care and heart disease, we have decided to not model these potential cost savings.

[37] We do not model the impact of any additional restorative care that may happen due to these visits, such as cavity fillings. It is likely that this restorative care is beneficial from a cost standpoint in the long run, because untreated dental caries and its consequences become more severe and expensive over time. However, it could also be that the increased restorative utilization outweighs these benefits. Our analysis implicitly assumes that these two offsetting effects are of equal magnitude.

results, we apportion the benefits of the system of adequate care to each mobile clinic visit in order to create an estimated per visit impact estimate.[38]

In the rest of this section, we summarize the methodology used to estimate the fiscal impact of the Virtual Dental Home project. For more information on model inputs and data sources, please see Appendix B.

FIGURE 1: MODEL OF PREVENTIVE CARE COSTS AND BENEFITS[39]



Services Received and Their Costs

We utilized information from the Virtual Dental Home project to estimate the percent of each population group that would receive one or more of the modeled treatments, as well as those who would receive preventive services for which we modeled no cost savings (e.g., exams or prophylaxis).[40] Meanwhile, the cost of the discrete preventive care services that we modeled was assigned based on the current Medi-Cal fee schedule, the actual average billed amount of these services from the Virtual Dental Home project, or the average cost per user based on the actual experience from the Medi-Cal program.

Impact of Care

To model the clinical effectiveness of each intervention, we identified relevant estimates from the published research literature. In general, we used average findings from multiple studies, findings from meta-analyses that reviewed multiple studies, or, in some cases, findings from single studies that best reflected the Virtual Dental Home project's services and population.

[38] For example, the benefits of fluoride varnish are experienced when children see the dentist at least 4 times before the age of three. In this case, we would divide the overall cost impact by four visits in order to get a per visit impact, which assumes that all four visits occur.

[39] DMFS is the acronym for decayed, missing, and filled tooth surfaces, a measurement of decay prevalence.

[40] Note that, based on our review of the literature, we did not model any clinical benefits from cleaning (prophylaxis) for children, although we did model a benefit for this procedure for adults.

For the adult populations studied, we utilized research on the impact of care on adults generally because no population specific research was available for the impact of dental care on elderly or disabled patients. To measure the impact of cleanings, we utilized the average of two published studies on the fiscal effects of these services for diabetic adults that analyzed the impact of preventive treatment on total medical costs. Both of these studies had positive results (i.e., preventive treatments were associated with lower total medical costs). Because research has not established a link between preventive dental care and subsequent dental or health care costs for adults generally, we include costs for healthy (i.e., non-diabetic) adults that receive care from the Virtual Dental Home project, but we do not show a fiscal benefit for these populations. For fluoride applications, we utilized findings from meta-analyses on the effectiveness of fluoride applications in reducing decayed teeth in order to estimate a percent reduction in decay.

For school-aged children, we were able to utilize studies that were specific to a school-age population. For fluoride applications, we utilized findings from meta-analyses on the effectiveness of fluoride varnish and fluoride gel in reducing decayed teeth in children in order to estimate a percent reduction in decay from these two services. For sealants, in particular, it was important to develop our model input assumptions based on a study that was representative of the high-risk, low-income population to be served by the Virtual Dental Home project.

For Head Start children, we used the average impact of two studies on the preventive Access to Baby and Child Dentistry (ABCD) program to estimate the percent change in total dental costs from a preventive visit. While the programs vary in many important ways, the studies of the ABCD program offer the most directly comparable source for estimating the likely effects of the Virtual Dental Home program. As such, we assume that the effect of increased preventive care in the ABCD and Virtual Dental Home programs will be similar. Although the findings of the two ABCD studies were mixed, the average of the studies is slightly positive.

Cost of Avoided Care

The last piece of the modeling effort consisted of estimating the California-specific costs to apply to the clinical effectiveness impacts discussed above. These costs varied depending on the patient population. For example, for adults we identified the impact of fluoride on tooth decay and the impact of cleanings (i.e. prophylaxis) and preventive periodontal treatments on medical costs. Thus, we needed to estimate the cost of tooth decay for those who receive fluoride treatments and the medical cost for those who receive preventive periodontal treatments (all specific to California SNF and ICF populations). For school-aged children, we know the impact of fluoride and sealants on tooth decay and so need to estimate the cost of treating tooth decay for this population. For Head Start children, we estimate the impact of a preventive visit on per capita dental costs generally, and so need an estimate of per capita dental costs for this population.

For both adults and children, the cost of decay is measured as the average per Medi-Cal beneficiary cost of restorative care. Restorative care includes treatments such as fillings, crowns, and root canals

that are used to treat teeth once they've decayed. It does not include the costs associated with preventive care, diagnostic tests, and tooth problems not associated with preventive care. For children, the cost of dentally related medical care obtained in hospitals is also added into the cost of restorative care. These costs are then calculated on a per beneficiary basis instead of a per user basis because not every patient treated by the project would have sought out care for their decayed teeth. In essence, we do not assume that all decay is treated in the future given the low utilization rate for the Medi-Cal population.

To estimate the total dental costs affected by preventive services for Head Start children, we utilize total cost per user for children under 6. Total costs include preventive, restorative, diagnostic, and other dental care services. In addition, we estimate the reduction in emergency room and hospital costs, which are calculated on the assumption that the project's patients utilize hospital care at the same rate as other Medi-Cal children.

Finally, we estimated the cost of medical care for adult diabetics in SNFs and ICFs. To do so, we first estimated the amount that Medi-Cal pays for two different types of SNF and ICF residents: those that are eligible for Medi-Cal and Medicare ("dual eligibles") and those that are only eligible for Medi-Cal. When patients are dual eligible, Medicare is the primary payer for most health services and Medi-Cal pays for non-covered services, premiums, and co-pays. For Medi-Cal only patients, Medi-Cal is the primary payer for all services, including hospital and office visits. Because Medi-Cal pays for LTC and these services represent a large portion of total costs but are unlikely to be affected by a patient's use of dental care, we estimated costs for medical care (i.e., non-LTC care) for both these groups. Next, since patients with diabetes have higher medical costs than average, we utilized a source on diabetics in the Medi-Cal population to adjust overall average costs to more accurately reflect medical costs for a patient with diabetes. Finally, since not every SNF and LTC patient receiving a preventive cleaning will have diabetes, we estimated the percent of the SNF and ICF patient populations that are likely to be diabetic.

RESULTS: ESTIMATED SAVINGS FOR THE MEDI-CAL PROGRAM

Using the input assumptions on clinical effectiveness and costs discussed above, we estimated the potential savings to the Medi-Cal program from increased use of the Virtual Dental Home project. Specifically, we estimate that a preventive dental visit in the Virtual Dental Home program would save $2 per elderly patient in an SNF, $17 per disabled patient in an ICF, and $2 per Head Start patient. For school-age children, the program does not decrease overall spending per patient. Instead, we estimate that the program will, on average, result in an overall net cost of $36per visit.

The average per visit cost savings for adults are driven by the medical cost savings for diabetics.[41] The benefits of fluoride treatment essentially cover the cost of the fluoride treatment for these

[41] The annual reduction in health care costs for patients with diabetes stemming from a preventive care dental visit is approximately 7%, according to the average result from the studies we reviewed. While these estimates are quite large,

populations, but they are not large enough to also cover the cost of the preventive periodontal treatments. Once again, this is because research has not established a link between a preventive care visit generally and improved health. Thus, we do not model a dental or health care cost benefit for the exam and services other than fluoride, even though they are likely to be important mechanisms for better oral health. But, because of the large savings for the population with diabetes, the overall impact for adults still shows a cost saving.

The reason school-aged patients do not show a greater savings, despite the fact that we estimate modest savings from the sealant and topical fluoride, is that there is a $15 exam cost and a $30 cleaning cost incurred for most children, regardless of whether those children receive cost-beneficial preventive care treatments.[42] As such, the exam and cleaning are simply treated as additional costs in the model without off-setting benefits. To the extent that the visit itself is a source of patient and parent education and a way to establish better oral health behavior (as opposed to simply being a way of screening populations to determine who needs follow-up restorative care or preventive services) it might well produce improvements in oral health and follow-on fiscal benefits. Future research into the benefits of preventive care generally for school age children is warranted to determine if a broader preventive care program can be cost-effective.

For example, if preventive visits for school age children had the same impact we estimate for young children (i.e., a 1 percent decrease in average annual dental costs), our model suggests that that preventive visits for school-aged children would save $3 per patient.

CONCLUSION

The Virtual Dental Home project offers the potential for an innovative, low cost method to improve dental outcomes for vulnerable populations in California. The research presented in this report suggests that there may be fiscal benefits for the Medi-Cal program as well, at least with respect to young children and adults in institutionalized settings. Results of our modeling suggest that for school-age children, the program can produce reductions in future health and dental care costs; however these fiscal benefits are not outweighed by the costs of the services provided. These results look only at the fiscal impact of the Virtual Dental Home project on the Medi-Cal program, and do not take into account important, but less tangible, benefits such as reduced days missed from school or work, decreased pain and suffering, or increased socialization, employability and self-esteem.

Beyond the specific results of our modeling efforts, one additional conclusion can be drawn from our work. Only limited research exists on the clinical and fiscal effects of broad-based preventive care programs such as the Virtual Dental Home project. We believe that additional research that captures

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they are derived from estimates contained in published research literature. Similar results have been found with respect to a reduction in cardiovascular disease. However, the American Heart Association has stated that there is no link between heart disease and dental care, and we therefore do not model any heart disease benefits here.

[42] Fees amounts used in the model reflect the 1 percent payment reduction currently in place for Medi-Cal.

the impact of the full range of potential dental care interventions, including benefits of screening exams and increased access to dental care (e.g., establishment of a dental home) is warranted. In addition, the results presented here are based on the current Denti-Cal reimbursement system for providers. It is possible that an alternative system that aligned provider payments with health outcomes would have a different result.

In general, our review of the research supports the conclusion that preventive dental procedures are effective, particularly if they are targeted to populations at risk for dental disease as used in the Virtual Dental Home model of care. As indicated, in most of the populations modeled, the health benefits of improved access to care could be realized while simultaneously producing savings for Medi-Cal program. Even with school-age children, where the results indicate a small cost to the State, the health benefits of this model of care could be realized at a relatively modest cost to the State.

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APPENDIX B: DETAILED METHODOLOGY

For the interested reader, we present detailed information on the sources and rationale used in calculating the impact of the modeled interventions. Also included are the end-of-the-line cost-benefit estimates for each intervention. These are combined with information on the utilization of these interventions from the Virtual Dental Home project in order to arrive at our final fiscal impact estimates for each population, which are presented in the body of the main report. All benefits and costs are expressed in 2010-11 dollars.

Impact of Fluoride on Adults

We utilize a meta-analysis on the effect of fluoride applications on adults to develop our input assumption about the decrease in decayed, missing, and filled tooth surfaces (DMFS) resulting from fluoride application. In this study, multiple types of fluoride application are combined, resulting in an overall estimate that use of fluoride will reduce decay by 25 percent. The studies of professionally-applied fluoride treatments indicate that the effectiveness is based on an average of two visits per year. Thus, we assume that each visit with topical fluoride will reduce decay by 12.5 percent, in both the elderly SNF and adult disabled ICF populations.[43]

Next, we estimate that a decrease in DMFS would produce a corresponding decrease in restorative costs per beneficiary. Restorative costs are measured as the total of restorative, endodontic, and oral and maxillofacial surgery costs for patients with Aged, Blind, and Disabled long-term care (LTC) aid codes in 2008-09 and 2009-10 (see **Error! Reference source not found.**).[44] Because restorative care only included minor restorative care services such as fillings and crowns, we included costs for endodontic and oral and maxillofacial surgery services to include the costs associated with treating decay once it has become more significant. Endodontic procedures include the treatment of the root and nerve of the tooth by procedures such as a root canal, while oral and maxillofacial procedures include the extraction and surgical removal of teeth. The endodontic and oral and maxillofacial surgery categories include some services that are not the direct result of decay. However, other costs related to decay such as the cost of sedation and hospital costs are not captured the included payment categories. Therefore, our overall restorative care cost measure should be considered an approximation of the actual restorative care cost per beneficiary. In addition, we utilize the costs associated with LTC patients because they capture the health status of individuals who are in an institutionalized setting. Our results, therefore, are based on the assumption that these individuals are representative of the entire population, including those who are only temporarily in a nursing facility (and may not have an LTC aid code).

[43] Griffin et al., "Effectiveness of Fluoride in Preventing Caries in Adults." Per visit result assumes two visits per year.

[44] Data provided by Lisa Simonson Maiuro, MSPH, Ph.D. of Health Management Associates (HMA), as part of a CHCF funded project to examine the impact of cuts in adult Medi-Cal dental services. Data were extracted from the Medi-Cal MIS/DSS and summary data were obtained from a performance measurement dashboard created by Dr. Maiuro and HMA.

Finally, we divide these estimated restorative costs by total beneficiaries instead of total users. This is done in order to account for the fact that not every patient would have sought out and received care for their decayed teeth.

FIGURE 2: AVERAGE RESTORATIVE CARE COSTS PER BENEFICIARY

Population	Definition	Cost
SNF Elderly	65+ with Aged, Blind and Disabled Long-Term Care Aid Codes	$12
ICF Disabled	21-64 with Aged, Blind, and Disabled Long-Term Care Aid Codes	$26

Combining the effectiveness and cost estimates, we find that fluoride saves $1 for an SNF patient (12.5% reduction in cost times $12 average cost/beneficiary = $1) and $3 for an ICF patient (12.5% reduction in cost times $26 average cost/beneficiary = $3). After accounting for the $6 cost of the fluoride application, Medi-Cal spends $4 additional dollars on an SNF recipient and $3 on an ICF recipient.[45]

Impact of Preventive Periodontal Treatment on Adults

In order to estimate the impact of preventive periodontal treatment (i.e. prophylaxis or "cleanings" and scaling and root planning) for adults, we modeled the net cost of the treatment by estimating treatment costs, medical cost savings, and the size of the different patient groups that would receive the treatment. We then applied treatment and medical cost savings to each group and estimated the overall average savings (or cost) per visit.

Medical Cost Savings

Our review of the published research on the impact of preventive dental care on health care costs suggests that a link exists for patients with diabetes, but not for the population generally. For the impact of preventive care on medical costs for patients with diabetes, we utilize the average of two cost studies. First, Taylor et. al. found that 1 to 2 non-surgical periodontal and prophylaxis procedures are associated with an 11 percent reduction in total medical costs.[46] Second, data from Albert et. al. indicate that diabetics with at least one visit with examination and preventive service had risk-adjusted costs that were 2 percent lower than diabetics who did not (i.e., those who had treatment visits and no visits). We utilize the average result from these two studies to estimate the impact of preventive care on medical costs. Because these reductions are the effect of at least 1, but possibly more visits, we divided the reduced medical costs by the mid-point (1.5) to estimate the per visit effect. No cost savings were estimated for patients without diabetes, although the cost of the preventive services was included in the model.

[45] Fees have taken into consideration the 1 percent payment reduction currently in place for Medi-Cal.
[46] Taylor et al., *Is Periodontal Treatment Associated with Lower Medical Costs in Adults with Diabetes? Findings in Blue Care Network 2001-2005*.

Next, we estimated the average amount that Medi-Cal pays per SNF and ICF dual and Medi-Cal only patient (known as per member per month or PMPM), and subtracted the estimated PMPM of long term care (LTC). The PMPM for LTC services was based on Medi-Cal data for total SNF and ICF service costs and average monthly SNF and ICF beneficiaries.[47] These LTC service costs were subtracted from the total amount spent on all services for beneficiaries that are identified as LTC residents (i.e., those with an LTC aid code).[48,49] Because LTC aid codes do not distinguish between SNF and ICF, it was assumed that SNF and ICF total PMPM both equaled the PMPM costs for LTC beneficiaries. Thus, we estimate that, for Medi-Cal only patients, Medi-Cal pays $1,069 PMPM for SNF residents and $2,563 PMPM for ICF residents.[50] Dual eligible medical costs are much lower at $347 for SNF residents and $131 for ICF residents.

While these estimates provide us with a measure of the average health care costs for the average SNF or ICF patient, they do not reflect the true average health care cost for patients with diabetes, who have higher medical costs than average. A 2009 study of the disabled Medi-Cal population found that Medi-Cal only disabled enrollees with diabetes had a per capita annual cost that was 1.3 times higher than average, while similar dual eligible enrollees had health care costs that were 1.5 times higher than average.[51] We applied these multiples to the average PMPM costs for SNF and ICF populations to arrive at an estimated cost per patient with diabetes.

Patient Population Groups

The next step in the modeling process was to estimate the fraction of the elderly SNF and disabled ICF patients that are in each group (i.e., dual-eligible w/diabetes, dual eligible w/o diabetes, Medi-Cal only w/diabetes and Medi-Cal only w/o diabetes). According to the 2009 California Health Interview Survey, 14 percent of Medi-Cal only and 26 percent of dual eligible beneficiaries over the age of 65 have diabetes. Meanwhile, 8 percent of Medi-Cal only and 24 percent of dual eligible adult citizens between

[47] Costs for SNF and ICF services are from "Table 2: PMPM Cost for FFS Medi-Cal Only Eligibles" and "Table 3: PMPM Costs for FFS Dual Eligibles" in State of California, Department of Health Care Services, *Medi-Cal Program Fee-For-Service Paid Claims and Certified Member Months for Fiscal Year 2009-2010 Months of Service 2009-07 - 2010-06*, August 2011. Number of beneficiaries with LTC services is from DHCS Research and Analytic Studies Branch, *Long-Term Services and Supports (LTSS) and Specific State Plan Services, Medi-Cal Only, Non-Eligible for Medicare: Average Monthly Users, Calendar Year 2010* and *Long-Term Services and Supports (LTSS) and Specific State Plan Services, Medi-Cal Dual Eligibles: Average Monthly Users, Calendar Year 2010*

[48] We utilize the costs associated with LTC patients because they capture the health status of individuals who are in an institutionalized setting (although we note that some patients in this setting do not have an LTC code). Our results therefore implicitly assume that those patients with an LTC aid code are representative in terms of their oral health status of the entire institutionalized populations served by the VDH program.

[49] Total Medi-Cal PMPM costs for LTC beneficiaries are from "Table 2: PMPM Cost for FFS Medi-Cal Only Eligibles" and "Table 3: PMPM Cost for FFS Dual Eligibles" in State of California, Department of Health Care Services, *Medi-Cal Program Fee-For-Service Paid Claims and Certified Member Months for Fiscal Year 2009-2010 Months of Service 2009-07 - 2010-06*, August 2011;

[50] Total costs for LTC enrollees is based on the LTC beneficiary code, which aggregates all costs for the enrollee.

[51] *Medi-Cal's Dual Eligible Population: Demographics, Health Characteristics and Costs of Health Care Services*, (Department of Health Care Services, 2009)

the ages of 18 and 65 have diabetes. Since these figures are for non-institutionalized and non-disabled populations, they are likely to be conservative estimates. For the ICF population, we can adjust for this fact by averaging the CHIS finding with estimates from the Department of Health Care Services which show that 17 percent of disabled Medi-Cal only and 31 percent of disabled dual-eligibles have diabetes.[52] Averaging the estimates from these sources, we estimate that 12.5 percent of ICF Medi-Cal only and 27.6 percent of ICF dual eligible have diabetes.

FIGURE 3: ESTIMATED PERCENT OF SNF AND ICF PATIENTS WITH DIABETES, BY COVERAGE TYPE

Patient Type	Estimated Percent With Diabetes
SNF Medi-Cal Only	14.4%
SNF Dual Eligible	25.7%
ICF Medi-Cal Only	12.5%
ICF Dual Eligible	27.6%

The mix of dual eligible and Medi-Cal only patients in SNFs and ICFs will determine how much is saved. These estimates are based on average monthly beneficiary counts for these services from Medi-Cal.[53] For SNF residents, 14 percent of patients will be Medi-Cal only and 86 percent will be dual eligible. On the other hand, 44 percent of ICF residents will be Medi-Cal only and 56 percent will be dual eligible.

Treatment Costs

We estimated the amount the cost prophylaxis and scaling and root planning procedures by using the Medi-Cal fee-for-service data. We used the average cost per SNF and ICF user of preventive and periodontal treatment as the average cost for this preventive dental care at the Virtual Dental Home. These off-setting costs were estimated to be $94 for SNF patients and $115 for ICF patients.

Results: Adults

We combine these population percentages with our cost savings to estimate an overall net cost or benefit per service and then combine the total weighted average cost per service to arrive at a total cost or benefit per visit. Detailed results are presented below:

[52] Ibid.

[53] DHCS Research and Analytic Studies Branch, *Long-Term Services and Supports (LTSS) and Specific State Plan Services, Medi-Cal Only, Non-Eligible for Medicare: Average Monthly Users, Calendar Year 2010*; DHCS Research and Analytic Studies Branch, *Long-Term Services and Supports (LTSS) and Specific State Plan Services, Medi-Cal Dual Eligibles: Average Monthly Users, Calendar Year 2010*

FIGURE 4: DETAILED RESULTS BY POPULATION AND SERVICE

	Weighted Net (Cost) Benefit Per Service				
Population Category	Exam	Fluoride	Preventive care	Other	Total
Skilled Nursing Facility	($8.25)	($2.14)	$10.61	$0.00	$0.22
Intermediate Care Facility	($8.25)	($2.29)	$28.55	$0.00	$18.01

Impact of Fluoride and Sealants on School-Aged Children

The procedure for estimating the impact of fluoride and sealants mirrored that used for SNF and ICF adults. Specifically, we modeled the net cost of the treatment by estimating treatment costs, dental and medical cost savings, and the size of the different patient groups that would receive the treatment (in this case high-risk vs non-high-risk children). We then applied treatment and cost savings estimates to each group and estimated the overall average savings (or cost) per visit.

Impact of Sealants on School-Aged Children

The published research on sealant use among children suggests that the risk level of the patient is an important determinant of the overall cost-effectiveness of sealants. In addition, models that assumed that children obtained the necessary restorative care were much more likely to find cost-savings than studies of actual dental care use in the Medicaid population. Since the Virtual Dental Home project will be targeting sealant use to high-risk Medi-Cal children, we relied upon research that provided outcomes for this specific group (i.e. a high-risk Medicaid population). Therefore, we utilize data from a study on treatment outcomes and costs from sealant use in a North Carolina Medicaid population to model the effect of sealants (Weintraub, et. al.).[54]

Weintraub et. al. report declines in the restorative costs associated with a sealed molar (as opposed to changes in total restorative costs). Meanwhile, the Medi-Cal data on dental costs for school-aged children reported total restorative costs and did not allow us to investigate the cost associated with specific teeth. Instead of making assumptions about what percent of these total costs are associated with unsealed molars, we simply utilize the dollar impact reported by the study. Taking into consideration the cost of the sealant, the study showed that the eight-year impact of a sealant was a $0.64 reduction in expenditures for that molar. In 2011 dollars, this equals $1.03. Assuming that four molars would be sealed at a time by the project, we estimate a $4 savings per child getting sealants.

Because studies indicate that children can end-up in the emergency room for preventable dental care, but Weintraub et. al.'s findings did not include the cost of restorative care in emergency rooms, we estimate the potential impact of sealants on this type of care. To do so, we utilize data on the amount paid by Medi-Cal for Sacramento County children that used emergency department and hospital users for a preventable dental problem.[55] Per user, Medi-Cal paid $253 on average to treat the outcomes of

[54] Weintraub et al., "Treatment Outcomes and Costs of Dental Sealants Among Children Enrolled in Medicaid."
[55] *Sacramento Children Deserve Better* (First 5 Sacramento, June 2010)

decayed teeth in hospitals. However, only 0.3% of Medi-Cal children wound up getting treatment in a hospital.[56] On a per beneficiary level, the cost of hospital care was $0.79. Thus, we assume that the project's patients would utilize hospital services at a similar level to other Medi-Cal children, and estimate that sealants would lower this per beneficiary cost. Because we do not know what percent of these hospital visits were due to problems that could have been prevented by using sealants, we simply assume that sealants would decrease the total hospital cost per beneficiary by the average annual decrease in restorations from sealants for high-risk children reported by Weintraub (7.1 percent). In total, we estimate that sealants save $0.45 per molar in emergency department costs over the 8 year period. In total, we estimate that sealants result in a net savings of $6 per year per recipient.

Impact of Fluoride on School-Aged Children

To estimate the impact of fluoride varnish on school-aged children, we utilized a meta-analysis that estimates that the effect of biannual fluoride varnish is a 46 percent decrease in DMFS.[57]

We assume that a decrease in DMFS would produce a corresponding decrease in restorative costs per beneficiary. Once again, we use restorative costs per total beneficiary with continuous eligibility instead of total users in order to account for the fact that not every patient would have sought out care for their decayed teeth. Restorative costs are measured as the total of restorative and endodontic care for patients between the ages of 6 and 20 in 2008-09 and 2009-10.[58] Because restorative care only included minor restorative care services such as fillings and crowns, we included costs for endodontic care to include the costs associated with treating decay once it has become more significant. Endodontic procedures include the treatment of the root and nerve of the tooth by procedures such as a root canal. The restorative cost per beneficiary for school-aged children is estimated to be $53 per year.

To estimate the annual savings of fluoride varnish, we multiply the percent reduction in DMFS (46 percent) times the annual cost of restorative care per beneficiary ($53 to arrive at a total savings of $24. We then divide this total by the number of applications (2) required to obtain this cost savings. We then subtract the amount paid for the fluoride varnish per visit ($8) and arrive at an estimated net savings of $4 per fluoride varnish patient.

[56] Beneficiary counts for Sacramento County are from State of California, Department of Health Care Services, *Medi-Cal Population by County as of July 2007*

[57] Marinho et al., "Fluoride Varnishes for Preventing Dental Caries in Children and Adolescents"; Valeria CC Marinho et al., "Fluoride Gels for Preventing Dental Caries in Children and Adolescents," in *Cochrane Database of Systematic Reviews* (John Wiley & Sons, Ltd, 2002), http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD002280/abstract; V C C Marinho, "Cochrane Reviews of Randomized Trials of Fluoride Therapies for Preventing Dental Caries," *European Archives of Paediatric Dentistry: Official Journal of the European Academy of Paediatric Dentistry* 10, no. 3 (September 2009): 183–191.

[58] Data provided by Lisa Simonson Maiuro, MSPH, Ph.D. of Health Management Associates (HMA), as part of a CHCF funded project to examine the impact of cuts in adult Medi-Cal dental services. Data were extracted from the Medi-Cal MIS/DSS and summary data were obtained from a performance measurement dashboard created by Dr. Maiuro and HMA.

Results: School-Aged Children

We combine these estimated per procedure net cost impacts with the costs for a dental exam and other services provided to estimate an overall weighted average total cost or benefit per visit. Detailed results are presented below:

FIGURE 5: WEIGHTED COST/SERVICE FOR SCHOOL AGED CHILDREN

	Service Type				
	Exam	**Sealants**	**Fluoride**	**Prophylaxis**	**Total**
Net Service Cost	($14.85)	$5.91	$4.31	($29.70)	
% Receiving Service	100%	47%	97%	96%	
Weighted Net Cost/Service	($14.85)	$2.78	$4.18	($28.51)	**($36.40)**

Impact of Preventive Visit on Head Start Children

Two studies on the cost impact of a Washington state program that increased preventive care access for young low-income children are used to estimate the potential impact of the Virtual Dental Home project for this population. The Access to Baby and Child Dentistry (ABCD) program uses community-based strategies to remove barriers to access including outreach, education, and provider recruitment. While the ABCD and VDH programs vary in some respects, the studies on the ABCD program offer the best available evidence for estimating the effect of preventive care for young children. As such, our modeling assumes that the effect of increased preventive care in the Virtual Dental Home program will mirror that of the ABCD program. Specifically, our results assume that the overall program effect of the VDH program will be the same as that of the ABCD program. As summarized earlier, the two studies found divergent cost effects. In a study of average per child dental expenditures in a county with the ABCD program and one without the program, it was found that costs were an average of 4 percent higher per dental user in the ABCD county over the seven years that were studied. On the other hand, a second study which examined the same program found that expenditures were an average of 6 percent lower for child who participated in the ABCD program over the two and half year study relative to those who did not participate. Due to the divergent results, we utilize the average of these two studies and estimate that the Virtual Dental Home will decrease the cost per child by 0.8%.

In California, we estimate that the annual dental care cost per young child (user) with Medi-Cal is $240. This figure represents the total amount spent on dental care for children aged 0 to 6 divided by the number of dental care users. It includes all dental care that was paid by Medi-Cal, including preventive, restorative, and diagnostic care. Because studies indicate that children can end-up in the emergency room for preventable dental care, the medical costs paid by Medi-Cal associated with emergency room costs are also included even though the studies did not measure the impact of the preventive services on these costs., In order to create a rough estimate of these savings, we assume that the same percentage reduction in dental care costs would apply to dentally related hospital and emergency room costs. The measure of emergency care is constructed using the same Sacramento data as used for

school-aged children and we estimate that 0.3 percent of the patients would utilize $253 in hospital costs. As such, we estimate the total dental cost per young service recipient with Medi-Cal as $241.

Combining the percent reduction and California cost, we estimate that a preventive visit will save Medi-Cal $$2. Because the cost of the visit itself is embedded in this figure, we do not account for any offsetting costs.

ABOUT THE AUTHORS

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