

## COVER STORY

# Reducing early childhood caries in a Medicaid population

## A systems model analysis

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**M**edicaid's Early and Periodic Screening, Diagnostic and Treatment benefit for children and the Children's Health Insurance Program both mandate comprehensive dental benefits<sup>1</sup> for the nearly one-half of US children enrolled at any time during the year. In the United States, early childhood caries (ECC)—tooth decay among children younger than 6 years—is highly prevalent<sup>2</sup> and strongly associated with children eligible for public insurance.<sup>3</sup> ECC treatment consumes a disproportionate share of Medicaid and Children's

Health Insurance Program dental expenditures because its conventional remedy often requires extensive and expensive dental repair with patients under general anesthesia in medical facilities.<sup>4</sup> Although dental repair restores function and esthetics, it does not arrest disease progression<sup>5</sup> because it does not affect underlying determinants of this chronic disease. A number of public health, behavioral,

educational, and pharmacologic approaches to ECC have been proposed to prevent and suppress caries activity, particularly among children of low income whose cavities frequently go untreated.

We previously reported findings of system dynamics modeling to assess the potential for chronic disease

### ABSTRACT

**Background.** Despite early childhood caries (ECC) being largely preventable, its repair accounts for a disproportionate share of Medicaid expenditures. In this study, the authors model disease reductions and cost savings from ECC management alternatives.

**Methods.** The authors apply system dynamics modeling to the New York State Medicaid population of young children to compare potential outcomes of 9 preventive interventions (water fluoridation, fluoride varnish, fluoride toothpaste, medical screening and fluoride varnish application, bacterial transmission reduction, motivational interviewing, dental prevention visits, secondary prevention, and combinations) and the effect of defluoridating New York City.

**Results.** Model simulations help project 10-year disease reductions and net savings from water fluoridation, motivational interviewing, and fluoride toothpaste. Interventions requiring health professionals cost more than they save. Interventions that target children at high risk, begin early, and combine multiple strategies hold greatest potential. Defluoridating New York City would increase disease and costs dramatically.

**Conclusions.** The variety of population-level and individual-level interventions available to control ECC differ substantially in their capacity to improve children's oral health and reduce state Medicaid expenditures.

**Practical Implications.** Using Medicaid and health department dollars to deliver ECC preventive and management interventions holds strong promise to improve children's oral health while reducing state dental expenditures in Medicaid.

**Key Words.** Caries; Medicaid; dental care for children; preventive dentistry; fluoridation; models; economic.  
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management to reduce ECC occurrence and progression among Colorado preschoolers of all income levels.<sup>6</sup> System dynamics modeling is a computer simulation technique that allows the user to anticipate the effect of interventions in complex situations with interdependent variables.

It is not predictive of the future but does “allow policy makers and program managers to consider resolutions of complex, multilayered, interactive issues in an organized way.”<sup>6</sup> Determination of Medicaid investments in disease management for young children is 1 such complex issue. Our Colorado findings helped us project 10-year intervention costs and associated savings, noting that interventions would yield the greatest benefit if they target the youngest children, would yield the greatest return on public investment if they target children at highest risk, and would be most effective with use of combinations of interventions that address multiple stages of ECC’s genesis and progression. Although some interventions saved more in dental repair than their cost, all produced substantial reductions in disease occurrence and associated repair costs. Building on these Colorado findings for all young children, we assess in this study the potential for ECC interventions to reduce cavity occurrence in toddlers and preschoolers who are poor and of low income in New York State (NYS) and help project savings that may accrue to the NYS Medicaid program through ECC management.

## METHODS

Our approach is predicated on the natural history of caries progression in young children. Children become at risk for ECC from birth as teeth erupt and children acquire caries-associated bacteria. They vary in caries risk and experience according to hereditary, familial, environmental, dietary, and developmental factors. Caries risk and activity increase with age from no disease; to the establishment of caries activity; to the development of visible cavities; and, if untreated, to the occurrence of symptoms and infections. This progression can be arrested and, to a limited degree, reversed. The nature of the disease and the population affected mean that children vary over time in at least 3 dimensions accommodated by the model: they grow from birth to age 6 years, their disease progresses through recognized stages at different rates related to risk, and their level of caries activity is affected by preventive and disease-suppressive interventions.

In our baseline model, we considered caries progression in the absence of any intervention for the 450,000 children younger than 6 years eligible for NYS Medicaid (56% in New York City [NYC]) on the basis of family incomes less than 133% of the federal poverty level. We then modeled interventions that change the rates of progression from 1 stage of disease to the next for their putative capacity to reduce cavity prevalence and

associated repair costs. The model provides intervention-specific costs, associated savings in avoided dental repair, and net savings (reduced costs for repair minus the cost of the intervention), thereby allowing practitioners and policy makers to consider the potential benefit in dollars saved for Medicaid and disease avoided for beneficiaries.

To allocate these children among groups of low, moderate, and high caries risk, we used NYS parental reports of the condition of their children’s teeth from the National Survey of Children’s Health 2007,<sup>7</sup> apportioning 62.9% to low risk on the basis of parents reporting “excellent or very good” dental condition, 25.8% to moderate risk on the basis of parents reporting “good” dental condition, and 11.3% to high risk on the basis of parental reports of “fair or poor” dental condition.

To allocate cavity occurrence within each risk group, we selectively adjusted National Survey of Children’s Health 2007 parent reports of children having “decay or cavities in the last six months” by clinical caries examination findings from the 1999-2002 National Health and Nutrition Examination Survey (NHANES),<sup>8</sup> thereby ensuring that overall caries prevalence equated to the 35% in the NHANES report. This method resulted in estimates of 18.1% cavity occurrence among young children at low risk, 57.3% among young children at moderate risk, and 77.9% among young children at high risk in NYS Medicaid.

We additionally extrapolated proportions of cavities that were untreated and the extent of cavities from NHANES. We estimated precavitation caries prevalence by using procedures described in the Colorado study.<sup>6</sup> We validated rates of dental treatment among affected children by using data from the 2004 Medical Expenditure Panel Survey.<sup>9</sup>

Data from NYS Medicaid and from the state’s all-payer hospital data set (Statewide Planning and Research Cooperative System) revealed that dental office restorative care for young children costs \$486 and that 2.6% of children additionally had obtained care in a hospital emergency department at a cost of \$375.<sup>10</sup> Approximately one in seven (13.8%) young children required treatment in the hospital operating room at an aggregate cost of \$4,630, composed of facility cost at \$3,128 after adjusting for cost-to-charge ratio of 0.429,<sup>11</sup> dental at \$866 (Jayanth Kumar, DDS, MPH, email communication, October 2013), anesthesia at \$485 (Jayanth Kumar, DDS, MPH, email communication, October 2013), and preoperative physical and laboratory expenses at \$151.<sup>12</sup>

For demographic trends, we used actual NYC and rest-of-state birth rates for preschoolers who were

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**ABBREVIATION KEY.** CWF: Community water fluoridation. ECC: Early childhood caries. MI: Motivational interviewing. NHANES: National Health and Nutrition Examination Survey. NYC: New York City. NYS: New York State.

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