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Cost-effectiveness of Treating Severe Childhood Caries under General Anesthesia versus Conscious Sedation

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Abstract

Background—Two common methods of treating pediatric dental patients with severe early childhood caries (S-ECC) are general anesthesia (GA) and conscious sedation (CS). We sought to first evaluate the cost-effectiveness of treating S-ECC with GA versus CS and then compare the cost-effectiveness at 2 time points: 2011 and 2015.

Methods—We used a decision tree model to produce 2-y estimates of costs and outcomes from the Medicaid perspective. The model cohort consisted of healthy 3-y-olds with S-ECC in need of a theoretical set of dental treatments to be performed under either a single GA visit or 3 CS visits. Outcomes were measured in caries-free months. Costs were evaluated in 2015 US dollars. Costs, probabilities, and outcomes were estimated from published data, expert opinion, and Medicaid billing at an academic health center. One-way and probabilistic sensitivity analyses were performed.

Results—As compared with CS, GA resulted in 4 additional caries-free months per child. The cost of a caries-free month for GA versus CS rose from \$596 in 2011 to \$881 in 2015. These findings were sensitive to loss to follow-up for subsequent CS visits and total cost of GA.

Conclusions—Comprehensive S-ECC treatment had better outcomes when performed under GA versus CS. However, GA was not cost saving when compared with CS. While the cost of dental treatment increased for both GA and CS from 2011 to 2015, the cost rose faster for GA. These results have important implications due to the increasing cost to Medicaid insurance and the rising number of young children being treated for S-ECC under GA.

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Author Contributions

J.M. Burgette, contributed to conception, design, data acquisition, analysis, and interpretation, drafted the manuscript; R.B. Quiñonez, contributed to data acquisition, analysis, and interpretation, critically revised the manuscript. Both authors gave final approval and agree to be accountable for all aspects of the work.

Keywords

dental care for children; Medicaid; decision making; costs and cost analysis; dentistry; preschool child

Introduction

In the United States, dental caries is the most common chronic childhood disease (National Institutes of Health 2000). It is 5 times more common than asthma (National Institutes of Health 2000) and is present in more than a sixth of young children (Fleming and Afful 2018). It begins early in life and is often accompanied by significant health, social, and economic consequences, particularly for disadvantaged children and their families (National Institutes of Health 2000; Albino and Tiwari 2016). In addition to being prevalent, dental caries can be severe. The severe form of dental caries in young children is severe early childhood caries (S-ECC), which is defined as 1 cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or a decayed, missing, or filled score 4 (age, 3 y), 5 (age, 4 y), or 6 (age, 5 y; American Academy of Pediatric Dentistry [AAPD] 2016a).

Due to the severe and generalized nature of S-ECC, the most common methods of pharmacologic management for pediatric dental patients with S-ECC are general anesthesia (GA) and conscious sedation (CS). Under GA, the child receives all needed dental treatment in 1 visit in a surgical setting, such as a hospital operating room. GA is defined as “a controlled state of unconsciousness accompanied by a loss of protective reflexes, including the ability to maintain an airway independently and respond purposefully to physical stimulation or verbal command” (AAPD 2015). Under CS, a child may require multiple visits to receive comprehensive treatment at the dental office and take sedative medication at the beginning of each visit. CS, also known as moderate sedation, is defined as “drug-induced depression of consciousness during which patients respond purposefully to verbal commands or after light tactile stimulation. No interventions are required to maintain a patent airway, and spontaneous ventilation is adequate” (AAPD 2015).

All states are federally mandated to provide comprehensive dental services for children aged <21 y under the Early and Periodic Screening, Diagnostic and Treatment (EPSDT) benefit (Centers for Medicare and Medicaid Services [CMMS] 2004). Minimum EPSDT dental services include “relief of pain and infections, restoration of teeth, and maintenance of dental health.” According to the CMMS, “many children with extensive dental disease or treatment needs—especially those with early childhood caries, high levels of anxiety about dental treatment, or special health care needs—require additional behavior management approaches which may include various forms of CS or, in some cases, treatment under GA.”

GA is often associated with significant cost (Griffin et al. 2000; Kanellis et al. 2000; Lee et al. 2000; Prabhu et al. 2006; Jameson et al. 2007; Lalwani et al. 2007). Limited data exist on the cost-effectiveness of GA versus CS for the treatment of S-ECC and temporal trends in dental costs associated with GA. Previous literature on dental rehabilitation under GA and CS included the following:

- A cost minimization study that relied on direct hospital and patient costs to evaluate relative-based value units for each treatment (Lee et al. 2000)
- Reports on direct hospital or Medicaid costs (Griffin et al. 2000; Kanellis et al. 2000; Prabhu et al. 2006; Jameson et al. 2007; Lalwani et al. 2007)
- Caries susceptibility and treatment failure rates following GA and CS (Hasty et al. 1991; Almeida et al. 2000; Eidelman et al. 2000; Lee et al. 2000; Peretz et al. 2000; Leelataweedwud and Vann 2001; Tate et al. 2002; Ashley et al. 2015)
- Changes in quality of life, dental fear, and preventive service use following treatment under GA and CS (Kupietzky and Blumenstyk 1998; Peretz et al. 2000; Jankauskiene and Narbutaite 2010)

The objective of this study was to evaluate the cost-effectiveness of treating healthy children with S-ECC with GA versus CS at 2 time points: 2011 and 2015. In the context of rising health care expenditures (Bodenheimer 2005; Aravamudhan et al. 2017), we sought to determine cost trends for S-ECC dental treatment over time and how they affect the cost-effectiveness of treatment. We hypothesized that higher operating room costs may worsen the cost-effectiveness of treating S-ECC with GA versus CS.

Methods

Model Cohort and Time Horizon

We developed a person-level decision tree model from the Medicaid perspective simulating 1,000 healthy 3-y-old children with S-ECC. We created a theoretical set of dental treatment needs to be used for this model based on an actual 3-y-old patient with S-ECC who was given the choice between GA and CS at the University of North Carolina at Chapel Hill (UNC). In this theoretical S-ECC case, which is the assumptive dental treatment performed in this model, comprehensive care required 1 pulpotomy, 2 stainless steel crowns, 2 resin crowns, 2 resins, 2 extractions, and 4 sealants (Appendix Table 1). The case was approached as a bundle for costs and outcomes. The hypothetical cohort had an American Society of Anesthesiologists risk of class I, indicating a healthy patient with minimal potential for suffering complications from GA and eligible for treatment under CS (ASA 2014). The decision to focus on 3-y-old children was guided by data from UNC indicating that the highest percentage of dental treatment under GA was performed at 47 mo old (Leelataweedwud and Vann 2001). The time horizon was 2 y, from ages 3 to 5 y, prior to the emergence of permanent teeth and including time for additional dental treatment needs following GA or CS.

Analytic Perspective

The analysis was performed from the Medicaid perspective, the primary health insurance provider for low-income Americans, because children insured by Medicaid are federally mandated to receive coverage for comprehensive treatment under EPSDT guidelines (CMMS 2004). We included only direct health care costs to Medicaid. Indirect and opportunity costs were excluded, such as those related to parental lost productivity, transportation, and child care.

Model Description and Assumptions

We developed a person-level decision tree model comparing the treatment of S-ECC under GA and CS (Fig.). The model cohort incurred costs (dollars) and outcomes (caries-free months) at each terminal node. Terminal nodes represented total costs and caries-free months for the 2-y treatment of each branch.

Model outcomes were accessed according to the following assumptions: 1) Patients adhered to “no food and drink intake” guidelines. 2) Full dental rehabilitation for S-ECC under GA and CS occurred by 3 mo of the new patient visit. 3) Full dental rehabilitation under CS visits took 3 visits. 4) Each of the 3 CS visits occurred no longer than 1 mo apart, with the first CS visit 1 mo after the new patient visit. 5) No caries-related treatment needs were present after full dental rehabilitation under GA and CS. 6) No caries-related treatment needs were detected at the 2- to 4-wk follow-up visit. 7) Patients attended all follow-up visits at 3, 6, 12, 18, and 24 mo, and additional caries-related treatment needs were addressed within 2 mo of each follow-up visit. 8) No other dental providers provided dental services on the model cohort.

Treatment of S-ECC under GA had 4 possible outcomes: 1) successful comprehensive treatment without complications, 2) successful comprehensive treatment with complications, 3) partial treatment with complications, and 4) unsuccessful treatment. Complications associated with GA include oxygen desaturation, apnea, laryngospasm, cardiopulmonary impairment, and death (Coté et al., 2016). We chose to include the risk of death as a complication for GA despite its rarity among healthy children. The risk of death is estimated at approximately 3.5 in 1 million (Da Silva 2008) with no deaths among 22,000 cases associated with GA among children over a 10-y period at UNC (Lee and Roberts 2003). Unsuccessful GA treatment included an inability to achieve proper and adequate GA for the patient, resulting in no dental treatment.

The CS arm had 3 identical cycles, representing 3 CS visits needed to successfully complete comprehensive dental treatment. For the theoretical S-ECC case, all teeth in 1 the following regions of the mouth were treated at each of the 3 visits: left posterior quadrants, upper anterior teeth, right posterior quadrants. Partial treatment indicated that all dental care was not completed for 1 region of the mouth during 1 cycle of CS. Reasons for partial CS treatment include disruptive behavior or completion of less treatment than planned, excluding adverse events. Following partial or complete treatment, families either continued with the next cycle of CS or comprehensive treatment under 1 GA visit. Additionally, families in the CS arm could be lost to follow-up.

Partial CS treatment with complications indicated that dental treatment for 1 region of the mouth during 1 cycle of CS was only partially completed due to an adverse event. The most common adverse events associated with the CS of pediatric patients in a dental setting include vomiting, oxygen desaturation, and apnea (Leelataweedwud and Vann 2001; Huang and Tanbonliong 2015). Additional adverse events include airway obstruction, laryngospasm, cardiopulmonary impairment, and death (Coté et al. 2016). Although the risk of unexpected death for a healthy child under CS is rare, with an estimation of approximately 1 in 2 million (Da Silva 2008), we included the risk of death as an adverse

event for CS. Following a complication with CS, families either continued treatment under GA or ceased further treatment. For the latter, the patient received 3 recall appointments 6 wk apart for aggressive preventive dental services to prevent further progression of S-ECC.

Unsuccessful treatment under CS indicated that treatment was aborted due to disruptive patient behavior that posed a risk to the patient and practitioner. Families either completed the remaining treatment under GA or not at all. If dental rehabilitation was not possible under GA and CS, the patient received 3 recall appointments 6 wk apart for aggressive preventive dental services to prevent further progression of S-ECC.

Model Inputs

The probabilities for the decision tree model were obtained from published literature (Table 1). For example, several probabilities for the CS arm of the model were obtained from a 5-y retrospective study at UNC (Leelataweedwud and Vann 2001). We relied on expert opinion from a 6-member panel for the remaining probabilities associated with GA and CS with minimal or no published literature. The expert panel had clinical and research backgrounds ranging from 3 to 15 y in pediatric dentistry, including the UNC faculty, pediatric dentistry residency, clinical research, and public health research.

Cost Estimates

Costs were calculated from the Medicaid payer perspective and modeled after typical medical and dental Medicaid reimbursement at the academic health care setting (UNC). Dental procedures were charged according to the UNC fee schedules for the years 2011 to 2012 and 2015 to 2016. We used typical Medicaid billing codes at UNC according to the American Dental Association's code on dental procedures and nomenclature to determine the dental-related costs. We reviewed typical Medicaid billing at UNC Hospitals to determine nondental costs associated with dental rehabilitation under GA and the cost of adverse events (Table 2). Detailed microcosting is available in Appendix Tables 2 and 3.

Treatment costs were accessed according to the following assumptions:

1. Patients were insured by Medicaid.
2. Oxygen desaturation resolved with no further hospitalization.
- 3) Estimated recovery room time was 30 min each for phases 1 and 2 for a total of 1 h.
- 4) Radiographs were obtained at 1- and 2-y follow-up visits.
- 5) Additional caries-related treatment needs were minimal (two 1-surface caries) and completed with traditional chair-side dentistry. Flexibility for each assumption was built into the 1-way and probabilistic sensitivity analyses.

Analytic Approach

We calculated the incremental cost-effectiveness ratio (ICER) as incremental costs over incremental effectiveness for 2011 and 2015. We used an inflation rate of 5% for 2011, a discount rate of 3%, and reported costs in 2015 US dollars. The outcome was caries-free months, which is the number of months without dental caries-related treatment needs (Appendix Table 4).

We performed 2 sensitivity analyses: 1) 1-way (deterministic) to determine the sensitivity of the model to uncertainty for each input parameter (Petitti 1999) and 2) probabilistic with Monte Carlo simulation (1,000 iterations) to determine the joint uncertainty of model parameters (Briggs 2000; Kim et al. 2015). For the 1-way sensitivity analysis, we used a range from the base case to capture a variety of costs and outcomes that may be incurred in nonacademic settings (Tables 2 and 4). As an example, the base case cost for the first CS visit is \$812, with a range of \$512 to \$1,112. For the probabilistic sensitivity analysis, we used beta distributions and method-of-moments approximations to capture the variability in expert opinion and published data for the transition probabilities (Table 1). We used gamma distributions to model the uncertainty for costs and caries-free months. Gamma distributions were specified to ensure that sampling distributions were centered at the base case estimate. Results from the probabilistic sensitivity analysis were presented in a cost-effectiveness plane and a cost-effectiveness acceptability curve.

Modeling, simulations, and cost-effectiveness curves were performed with Excel 2013 and Crystal Ball (Fusion Edition 11.1.2.1; Oracle).

Results

Base Case Scenario for 2011 and 2015

As compared with CS, GA resulted in a greater number of caries-free months (Appendix Table 4). The treatment of 1,000 healthy 3-y-old children with S-ECC resulted in 19,178 caries-free months over the 2-y time horizon under GA (Table 3). In comparison, treatment of 1,000 healthy 3-y-old children with S-ECC resulted in 15,016 caries-free months under CS. Therefore, S-ECC treatment for the cohort of 1,000 healthy 3-y-old children resulted in 4,162 additional caries-free months under GA over CS during the 2 y. On average, each child treated under GA gained an additional 4 caries-free months over the 2-y time horizon.

However, GA was also more costly than CS, and the cost rose faster for GA than CS between 2011 and 2015. For CS, the cost of the caries-free months for the entire cohort of 1,000 health 3-y-olds over 2 y was \$7,618,852 in 2011 and \$9,375,437 in 2015. In comparison, the 2-y cost of caries-free months for the entire cohort of 1,000 health 3-y-olds was \$10,101,124 in 2011 and \$13,042,485 in 2015 when treated under GA. In 2011, there was a 90% probability that GA was more cost-effective than CS if Medicaid was willing to pay \$878 more per caries-free month (Appendix Fig. 1). Similarly, if Medicaid was willing to pay \$1,162 more per caries-free month, there was a 90% chance that GA was more cost-effective than CS in 2015 (Appendix Fig. 1).

Similar to the increasing cost of GA versus CS between 2011 and 2015, the ICER between the treatments grew from 2011 to 2015 (Table 3, Appendix Fig. 2). In 2011, treating S-ECC under GA cost an additional \$2,482,272 for the entire cohort of 1,000 health 3-y-olds as compared with CS, resulting in an average of \$2,482 more per child. The ICER for S-ECC treatment under GA versus CS was \$596 per caries-free month for the 2-y time horizon in 2011. Comparatively, treating S-ECC under GA in 2015 cost an additional \$3,667,048 for the entire cohort of 1,000 health 3-y-olds as compared with CS, resulting in an average of \$3,667 more per child versus CS. The ICER for S-ECC treatment under GA versus CS was

\$881 per caries-free month for the 2-y time horizon in 2015. The cost of a caries-free month increased \$285 from 2011 to 2015. The cost-effectiveness plane illustrates that GA results in higher incremental costs and more incremental caries-free months as compared with CS in 100% of the simulations for 2011 and 2015 (Appendix Fig. 2).

Sensitivity Analyses

The cost per caries-free month was sensitive to loss to follow-up for subsequent CS visits, additional caries-related dental treatment needs following GA, total GA costs, and the cost of the first CS visit (Table 4). For example, increasing the cost of GA from \$12,531 to \$13,331 changed the 2015 ICER of \$881 per caries-free month to \$959.

Discussion

This study highlights the effectiveness and disproportional increase in costs associated with treating S-ECC under GA as compared with CS. Specifically, our results demonstrated 2 main findings. First, treating S-ECC was more effective with GA versus CS, resulting in 4 additional caries-free months over the 2-y time horizon. We found that S-ECC can be successfully treated under both GA and CS, but treatment was more effective under GA. When combined with evidence of increasing parental acceptance of pharmacologic treatment for young dental patients (Patel et al. 2016) and media attention to dental treatments under GA and CS (Saint Louis 2012, 2017), S-ECC treatment under GA may be on the rise.

GA and CS are both necessary treatments options that take children out of pain, remove dental infection, and improve quality of life (Jankauskiene and Narbutaite 2010; Malden et al. 2008). The importance of receiving dental treatment, especially for S-ECC, is supported by the AAPD (2015, 2016b). Our finding—that GA was more effective than CS at treating S-ECC—is consistent with the previous literature (Lee et al. 2000). However, the increased effectiveness GA versus CS resulted in a higher cost to Medicaid insurance.

Our second main finding was that GA was not cost saving as compared with CS. While costs for treating S-ECC increased for both GA and CS from 2011 to 2015, the cost of GA rose faster. Consequently, the cost of a caries-free month for GA versus CS increased by \$285 from 2011 to 2015. The increased cost of GA and CS from 2011 to 2015 mirrors the rising cost of health care overall (Bodenheimer 2005) and dentistry in particular (CMMS 2016; Aravamudhan et al. 2017). National health expenditures for dental services increased 4.2% in 2015, as opposed to 2.4% in 2014, to a total of \$117.5 billion (CMMS 2016). Rising costs strain federal and state budgets for Medicaid. In the context of increasing costs for health care, including GA for comprehensive dental treatment, states are considering policy changes, such as Medicaid expansion and coverage for dental services.

The repercussions of excluding treatment for severe dental caries in young children can be significant with regard to costs and outcomes. Currently, Medicaid-insured children are more likely than other children to have untreated caries (Brickhouse et al. 2008). The lack of providing medically necessary care can result in more severe dental disease with higher cost and less efficacious alternatives, such as emergency room visits without definitive treatment.

The costs included in this study were limited to the Medicaid payer. However, there are additional costs and consequences to the families of children with S-ECC, such as pain, anxiety, difficulty eating and sleeping, transportation, loss of work, and absence from school (Malden et al. 2008; Jankauskiene and Narbutaite 2010; Jackson et al. 2011). If Medicaid moves to cost sharing, families may be less likely to proceed with necessary dental treatment. The importance of accessing necessary dental treatment by families of children with Medicaid insurance, such as GA, was brought to the spotlight with the tragedy of Demonte Driver in 2007 (Edelstein 2009).

Our model included an option for aggressive preventive services against further progression of S-ECC when GA and CS were not possible. At the time of the study, 2011 and 2015, aggressive preventive services included frequent applications of fluoride varnish and oral health education. Additional modalities have recently become more widely available with Medicaid reimbursement, such as silver diamine fluoride. Future modeling can incorporate silver diamine fluoride as an aggressive preventive strategy that may reduce the need for GA and CS.

Limitations

This study has several limitations. First, our results are specific to the theoretical dental treatments selected for the model. Children with S-ECC require different treatments particular to their specific cases, and clinicians may choose to perform different dental treatments on patients with the same clinical presentation. S-ECC case selection and variability in dental treatment selection by the clinician are beyond the scope of this study, which focused on whether this particular set of treatment needs were cost-effective in GA versus CS. Second, the assumptions of this model reflect a best-case scenario for seeking comprehensive dental treatment, such as attending all follow-up visits after dental treatment. This is noteworthy because we found that the results are sensitive to loss to follow-up for CS. Third, there is no known threshold for an acceptable cost for a caries-free month. If the threshold was \$700, then there would be different implications for the cost-effectiveness of GA over CS in 2011 versus 2015. Fourth, it is up to the policy makers, families, practitioners, and the public to determine if a difference in 4 caries-free months between GA and CS is significant. For example, if S-ECC is associated with pain for some or all of that 4-mo period, then the timely and effective receipt of needed dental treatment under GA may have more value according to certain stakeholders.

Conclusion

The results of this comparative effectiveness research provide useful information about the effectiveness and costs of dental treatment options for S-ECC; however, this information is not guaranteed to lead to significant cost savings. A long-term solution for decreasing costs associated with S-ECC treatment will require more than cost-shifting to patients, other services, or payers. Rather, a long-term solution will address the cause of the underlying disease and take steps to prevent its occurrence. Dental caries is largely preventable. Targeting prevention efforts at children who are at risk for this severe and costly form of childhood caries may prove to be a wise use of Medicaid resources in light of the rising costs for GA. The increased cost of a caries-free month for a child with S-ECC from 2011 to

2015, particularly for GA, is a call to action to enforce dental visits by age 1 y and aggressive preventive dental public health programs to prevent S-ECC by age 3 y.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Knowledge Transfer Statement

Medicaid policy makers can use the results of this study to evaluate the cost-effectiveness of dental treatment for young children with S-ECC at 2 time points: 2011 and 2015.

Compared with CS, GA resulted in a longer amount of time during which children were free from dental caries but at a higher cost. The cost difference rose from 2011 to 2015.

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Figure.

Decision tree model of treating severe early childhood caries with general anesthesia versus conscious sedation.

Table 1.
Transition Probabilities for the Treatment of Severe Early Childhood Caries Decision Tree Model.

Transition Probabilities	Value	Range	Source
General anesthesia subtree			
Successful comprehensive treatment without complications	0.955	0.905 to 1.0	Expert panel
Successful comprehensive treatment with complications	0.03	0.01 to 0.05	Expert panel; Lalwani et al. 2007; Needleman et al. 2008; Mayeda and Wilson 2009; Canteikin et al. 2014
Partial treatment with complications	0.005	0 to 0.01	Expert panel
Unsuccessful treatment	0.01	0 to 0.02	Expert panel; Lalwani et al. 2007
Additional caries-related treatment needs present conditional on successful treatment	0.59	0.29 to 0.89	Almeida et al. 2000; Eidelman et al. 2000; Peretz et al. 2000; Tate et al. 2002
Conscious sedation subtree (all cycles)			
Unsuccessful treatment	0.05	0.02 to 0.08	Malviya et al. 2000; Leelataweedwud et al. 2001
To general anesthesia conditional on unsuccessful treatment	0.99	0.9 to 1.0	Expert panel
Partial treatment with complications	0.03	0.02 to 0.04	Hasty et al. 1991; Needleman et al. 1995; Rohlfing et al. 1998; Pena and Krauss 1999; Coté et al. 2000; Leelataweedwud et al. 2001; de Blic et al. 2002; Lee and Roberts 2003; Sheroan et al. 2006; Costa et al. 2012; Lourenco-Matharu et al. 2012; Ritwik et al. 2013; McCormack et al. 2014; Huang and Tanbonliong 2015
To general anesthesia conditional on partial treatment	0.99	0.98 to 1.0	Expert panel
Partial or complete treatment without complications	0.92	0.89 to 0.95	Leelataweedwud et al. 2001
To general anesthesia conditional on successful treatment	0.16	0.12 to 0.2	Expert panel
No further treatment conditional on success	0.12	0.09 to 0.15	Leelataweedwud et al. 2001
Continue treatment conditional on success	0.72	0.69 to 0.75	Leelataweedwud et al. 2001
Additional caries-related treatment needs present conditional on successful treatment	0.74	0.54 to 0.94	Almeida et al. 2000; Eidelman et al. 2000; Peretz et al. 2000; Tate et al. 2002

Table 2.
Cost for the Treatment of Severe Early Childhood Caries under General Anesthesia and Conscious Sedation.

Description	Cost, \$ ^a	Range	Source ^b
2011			
General anesthesia			
Total costs	9,616.95	8,816.95 to 10,416.95	Graduate pediatric clinic, UNC Hospitals, and faculty dental practice ^c
Complications	105	55 to 155	UNC Hospitals
Conscious sedation visit^d			
1	812.7	512.7 to 1,112.7	Graduate pediatric clinic and UNC Hospitals
2	639.45	439.45 to 839.45	Graduate pediatric clinic
3	399	199 to 599	Graduate pediatric clinic
Follow-up			
1 (3 mo)	84	64 to 104	Graduate pediatric clinic
2 (6 mo)	84	64 to 104	Graduate pediatric clinic
3 (12 mo)	108.15	88.15 to 128.15	Graduate pediatric clinic
4 (18 mo)	84	64 to 104	Graduate pediatric clinic
5 (24 mo)	108.15	88.15 to 128.15	Graduate pediatric clinic
Additional caries-related treatment needs present	195.3	45.3 to 345.3	Graduate pediatric clinic
2015			
General anesthesia			
Total costs	12,531	11,731 to 13,331	Graduate pediatric clinic, UNC Hospitals, and dental faculty practice ^c
Complications	100	50 to 150	UNC Hospitals
Conscious sedation visit^d			
1	812	512 to 1,112	Graduate pediatric clinic and UNC Hospitals
2	626	426 to 826	Graduate pediatric clinic
3	404	204 to 604	Graduate pediatric clinic
Follow-up			
1 (3 mo)	89	69 to 109	Graduate pediatric clinic

Description	Cost, \$ ^a	Range	Source ^b
2 (6 mo)	89	69 to 109	Graduate pediatric clinic
3 (12 mo)	112	92 to 132	Graduate pediatric clinic
4 (18 mo)	89	69 to 109	Graduate pediatric clinic
5 (24 mo)	112	92 to 132	Graduate pediatric clinic
Additional caries-related treatment needs present	204	54 to 354	Graduate pediatric clinic

Detailed microcosting is presented in Appendix Tables 2 and 3.

^a All costs are presented in 2015 US dollars.

^b Graduate pediatric clinic: Dental treatment performed under conscious sedation and traditional chairside dentistry at the University of North Carolina is billed according to the School of Dentistry graduate pediatric dentistry program fee schedule (2011 to 2012 or 2015 to 2016). UNC Hospitals: University of North Carolina Hospitals typical Medicaid reimbursement for dental patients undergoing general anesthesia. Faculty dental practice: Dental treatment performed under general anesthesia at the University of North Carolina is billed according to the School of Dentistry faculty dental practice fee schedule (2011 to 2012 or 2015 to 2016).

^c University of North Carolina Hospitals typical Medicaid reimbursement for dental patients undergoing general anesthesia. Preoperative medical appointment included a medical examination and anesthesia workup.

^d Nonintravenous conscious sedation included medical monitoring and sedation medication. Physician physical evaluation prior to conscious sedation visits included a medical examination.

Base Case Costs, Outcomes, and Incremental Cost-effectiveness for the Treatment for Severe Early Childhood Caries under General Anesthesia versus Conscious Sedation.

Table 3.

Treatment	Costs, \$ ^a	Caries-free Months ^b	Incremental		
			Costs, \$	Caries-free Months	Cost-effectiveness Ratio, \$ ^c
2011					
Conscious sedation	7,618,852	15,016	2,482,272	4,162	596
General anesthesia	10,101,124	19,178			
2015					
Conscious sedation	9,375,437	15,016	3,667,048	4,162	881
General anesthesia	13,042,485	19,178			

^aCosts are reported in 2015 US dollars.

^bNumber of months without dental caries (tooth decay).

^cReported as 2015 US dollars / caries-free months.

Table 4.

Deterministic Sensitivity Analysis Comparing the Treatment for Severe Early Childhood Caries under General Anesthesia versus Conscious Sedation.

Input Description	Input Values			Incremental Cost-effectiveness Ratio, \$ ^a		
	Base Case	Minimum	Maximum	Minimum	Maximum	Magnitude of Difference
Probabilities						
No further CS treatment conditional on successful past CS visit	0.12	0.09	0.15			
2015				1,035	727	308
2011				718	475	243
Partial or complete CS treatment without complications	0.92	0.89	0.95			
2015				793	1,037	244
2011				550	680	130
Continue CS treatment conditional on successful past CS visit	0.72	0.69	0.75			
2015				793	1,017	224
2011				546	674	128
Additional caries-related treatment needs present conditional on successful GA treatment	0.59	0.29	0.89			
2015				804	972	168
2011				542	661	119
Costs						
GA total costs						
2015	12,531	11,731	13,331	803	959	156
2011	9,616.95	8,816.95	10,416.95	519	674	115
CS visit 1						
2015	812	512	1,112	953	809	144
2011	812.7	512.7	1,112.7	669	524	145

Only parameters that alter the incremental cost-effectiveness ratio >\$100 are reported.

CS, conscious sedation; GA, general anesthesia.

^aReported as 2015 US dollars / caries-free months.