Time and Cost Analysis: Pediatric Dental Rehabilitation with General Anesthesia in the Office and the Hospital Settings

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Pediatric dental patients who cannot receive dental care in the clinic due to uncooperative behavior are often referred to receive dental care under general anesthesia (GA). At Stony Brook Medicine, dental patients requiring treatment with GA receive dental care in our outpatient facility at the Stony Brook School of Dental Medicine (SDM) or in the Stony Brook University Hospital ambulatory setting (SBUH). This study investigates the time and cost for ambulatory American Society of Anesthesiologists (ASA) Class I pediatric patients receiving full-mouth dental rehabilitation using GA in these 2 locations, along with a descriptive analysis of the patients and dental services provided. In this institutional review board–approved cross-sectional retrospective study, ICD-9 codes for dental caries (521.00) were used to collect patient records between July 2009 and May 2011. Participants were limited to ASA I patients aged 36–60 months. Complete records from 96 patients were reviewed. There were significant differences in cost, total anesthesia time, and recovery room time ($P < .001$). The average total time (anesthesia end time minus anesthesia start time) to treat a child at SBUH under GA was 222 ± 62.7 minutes, and recovery time (time of discharge minus anesthesia end time) was 157 ± 97.2 minutes; the average total cost was \$7,303. At the SDM, the average total time was 175 ± 36.8 minutes, and recovery time was 25 ± 12.7 minutes; the average total cost was \$414. After controlling for anesthesia time and procedures, we found that SBUH cost 13.2 times more than SDM. This study provides evidence that ASA I pediatric patients can receive full-mouth dental rehabilitation utilizing GA under the direction of dentist anesthesiologists in an office-based dental setting more quickly and at a lower cost. This is very promising for patients with the least access to care, including patients with special needs and lack of insurance.

Key Words: Pediatric dentistry; Dental anesthesia; Cost analysis; Operating room; Office-based anesthesia; Health economics.

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General anesthesia (GA) may be indicated for pediatric dental patients with extensive restorative treatment or difficult treatment plans, uncooperative behavior, severe anxiety or fear, physical or mental challenges, or for patients who are very young. However, GA is a costly method of delivering dental care and is often poorly reimbursed.^{1–5} In a study by

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Lewis and Nowak,⁴ pediatric dental program directors responded to a survey about the patient population cared for at their respective institutions. In the survey, 81% of program directors requested additional operating room (OR) time, but only 46% were granted their request. Furthermore, program directors mentioned the following:

- “Our (anesthesiology) department does not want to give us more time because they are poorly paid by Medicaid.”
- “In our state, reimbursement for anesthesia services by Medicaid is low. . . it is actually cheaper for them (medical anesthesiologists) not to work than to take what Medicaid pays.”
- “In hospitals, when the ORs can be filled with commercial, high-turnover cases, rather than long Medicaid dental cases that are inadequately reimbursed, OR time is difficult to come by!”⁴

A few studies have provided evidence to validate these anecdotal substantiations from program directors. In 2000, Kanelis et al⁵ found that \$2009 was the total cost (in allowed charges) to the Medicaid program of treating a child under GA for dental rehabilitation in the hospital. To put this into perspective, GA for Medicaid-eligible children under 6 years of age accounts for 25% of Iowa's Medicaid dental expenditures. Despite this significant portion of the budget, however, fewer than 2% of Medicaid-eligible children receive dental treatment with GA.⁵

In addition to medical and dental fees associated with treatment in the OR, there are also indirect and intangible costs, such as family/caretaker time, societal drawbacks, and missed opportunities.⁶ For example, parents and/or other family members may need to take time off of work, thereby interfering with normal daily routines, which is especially difficult in complex family situations or for patients who live in group homes. A child who requires dental care in the OR fragments the routine that plays an integral role for patients with special needs, whether that routine and sense of normalcy involves a group home, a school setting, or a traditional home. However, it is also important to note that dental rehabilitation anesthesia cases are typically treated in a single visit. In comparing GA to other behavioral management treatment modalities, dental rehabilitation using GA often requires a single visit to the OR, whereas other modalities such as moderate (conscious) sedation with local anesthesia may necessitate more than 1 visit to complete treatment. In fact, Lee et al⁶ used cost modeling to establish that, if a child needs more than 3 moderate (conscious) sedation visits, GA is less costly than sedation. Furthermore, their group showed that it is important to compare societal and opportunity costs, in addition to actual medical and

dental fees, when evaluating the extent of treatment and behavioral management strategies necessary to complete care.⁶

Parental acceptance of GA as a behavioral management technique is gaining acceptance. Early studies in the 1980s and 1990s ranked GA and papoose boards as the least acceptable techniques for behavioral management in parental surveys.^{7,8} As shown in Table 1, contemporary studies provide evidence that advanced pharmacologic management (sedation and GA) is gaining approval with parents, ranking third in acceptability behind tell-show-do and nitrous oxide–oxygen minimal sedation, while passive restraint remains at the bottom of the list.⁹ Two studies of note observed that parents of preschool children who undergo dental treatment with GA express a high degree of acceptance and positive social impact on their child.^{10,11} According to parental observations, the majority of young children showed considerable improvement following dental treatment under GA in their oral health–related quality of life with respect to the impact of oral health and disease on the child's daily functioning and social well-being, including chewing, swallowing, and speaking.¹²

In the present study, we conducted a retrospective cross-sectional analysis of American Society of Anesthesiologists (ASA) Class I preschool-aged patients to compare the time and cost of dental rehabilitation using GA in our university hospital–affiliated ambulatory location (Stony Brook University Hospital [SBUH]) and at our outpatient dental school setting (Stony Brook School of Dental Medicine [SDM]), which operates as an office-based venue. We hypothesized that there would be time and cost savings with dental treatment performed under GA provided by dentist anesthesiologists (DAs) in our outpatient dental school setting. If our hypothesis proves to be true, increased use of outpatient settings would provide greater access to care at lower costs and with improved time efficiency.

PATIENTS AND METHODS

Patient Population

This is a retrospective analysis that received Institutional Review Board approval from Stony Brook Medicine, Stony Brook, NY. We identified records that met the following inclusion criteria:

1. Received GA for dental treatment between July 2009 and May 2011,
2. ICD-9 code for dental caries (521.00),
3. ASA Class I patients, and
4. Age 36–60 months.

Table 1. Techniques Ranked By Acceptability (Greatest To Least) In 3 Similar Studies, As Printed in Eaton et al, 2005. Note Emphasis Added with General Anesthesia Highlighted

Murphy et al ¹ 1984	Lawrence et al ³ 1991	Present study 2003
1. Tell-show-do	1. Tell-show-do	1. Tell-show-do
2. Positive reinforcement	2. N ₂ O	2. N ₂ O
3. Mouth prop	3. Voice control	3. General anesthesia ★
4. Voice control	4. Active restraint	4. Active restraint
5. Physical restraint, dentist	5. Hand-over-mouth	5. Oral premedication
6. Physical restraint, assistant	6. Papoose Board	6. Voice control
7. Hand-over-mouth	7. Oral premedication	7. Passive restraint
8. Sedation	8. General anesthesia ★	8. Hand-over-mouth
9. General anesthesia ★		
10. Papoose Board		

* Vertical lines indicate mean values that were not significantly different between tests (ANOVA and Tukey test).

Two patients were excluded because they were previously admitted as inpatients as the result of a coexisting dental infection that had to be treated emergently in the OR.

Treatment Facilities

All patient treatment was provided at either the ambulatory hospital location at SBUH or the outpatient facility at the SDM, which was staffed by DAs. The venues are equipped similarly with all of the appropriate equipment for GA and patient monitoring. Stony Brook Medicine is a teaching institution, and as such, pediatric dental residents and dental anesthesia residents with attending supervision provide dental care and anesthesia management, respectively.

Outcome Measures and Analysis

The records of qualifying patients were examined according to demographics, including age, gender, past medical history, and insurance status (private payor vs Medicaid). Outcome measures included the number and types of dental procedures completed; duration (pre-procedure time, total anesthesia time, and recovery time); and costs (total, both indirect and direct, excluding professional fees for pediatric dentists and anesthesiologists), as shown in Table 2. Patient characteristics were analyzed using descriptive statistics. The Wilcoxon rank sum test was used for continuous variables and the Fisher exact test was used for categorical variables to compare patient characteristics and treatments provided at the 2 sites (SBUH and SDM). In addition, multiple linear regression models were used to compare time and cost after adjusting for potential confounding factors. To meet the assumption requirements, logistic transformation was applied to all 3 response variables (total anesthesia time, recovery time, and cost). All analyses were completed with SAS 9.2 (Cary, NC) and statistical significance was considered at $P < .05$.

Our retrospective analysis included 96 ASA I, pre-school-age patients with dental caries; 50 patients were treated at the outpatient facility within the SDM and 46 patients were treated at SBUH (Table 3). There were no statistical differences in age, sex, insurance status, or past medical history in children treated at SBUH versus SDM. More dental procedures were completed at SBUH (mean = 14.9 vs 10.8 for SDM), but more restorations were placed at SDM (mean = 4.7 vs 3.7 for SBUH; Figure). Even after the statistics were adjusted for confounding variables (anesthesia time and number of procedures), the hospital setting had longer preoperative time, longer

RESULTS

Table 2. Outcome Measures and Definitions

<i>Outcome Measure</i>	<i>Definition*</i>
Dental procedures	Quantity and type of dental procedure performed (restorations, pulpotomy, stainless steel crowns, extractions)
Preprocedure time	Time patient arrives at venue for dental rehabilitation until they enter operating room (SBUH) or treatment room (SDM)
Total anesthesia time	Total time patient is under general anesthesia (calculated by subtracting anesthesia start time from anesthesia end time)
Recovery time	Time patient arrives in recovery room until discharge from SBUH or SDM
Costs	Summation of direct and indirect costs (excludes professional fees for pediatric dentists and anesthesiologists) <ul style="list-style-type: none"> • Direct costs <ul style="list-style-type: none"> ◦ Fixed, ie, x-ray machine, x-ray sensor ◦ Variable, ie, composite, amalgam • Indirect <ul style="list-style-type: none"> ◦ Fixed, ie, hospital administrator ◦ Variable, ie, registered nurse, dental assistant

* SBUH indicates Stony Brook University Hospital ambulatory setting; SDM, Stony Brook School of Dental Medicine.

anesthesia time, and longer recovery time at a higher cost (Table 3). These comparative data indicate the following:

- Preoperative time: 30 minutes (SDM) versus 120 minutes (SBUH)
- Average anesthesia time: 175 minutes (SDM) versus 222 minutes (SBUH)
- Average recovery time: 25 minutes (SDM) versus 157 minutes (SBUH)
- Total cost: \$414 (SDM) versus \$7303 (SBUH)

DISCUSSION

The present study demonstrates that performing full-mouth dental rehabilitation utilizing GA provided by DA residents and faculty on ASA I pediatric patients in an office-based setting, such as the SDM, minimizes costs and decreases treatment time. The average cost per case at SBUH of \$7303, or \$19.27 per minute in the OR in SBUH, confirms data published by Wilson in 2004, in which the facility fee for GA was \$10–\$30/minute.¹³ Moreover, when controlling for anesthesia time and procedures, the cost associated with receiving treatment

Table 3. Demographic, Time, and Cost Data from SDM and SBUH for ASA I Patients with a Diagnosis of Dental Caries, Aged 36–60 Months*

<i>Variable</i>	<i>SDM</i>	<i>SBUH</i>	<i>P value</i>
N	50	46	
Mean age (mo)	51.4 ± 7.9	48.9 ± 9.0	NS
Female, n (%)	24 (48.0%)	21 (45.7%)	NS
Significant PMH (%)	21.7	12.0	NS
Medicaid/Medicaid HMO (%)	72.0	84.8	NS
Mean preoperative time (min)	30	120	< .0001
Mean anesthesia time (min)	175 ± 36.8	222 ± 62.7	< .0001
Mean recovery time (min)	25 ± 12.7	157 ± 97.2	< .0001
Total facility cost (\$)	414†	7303 ± 2098‡	< .0001
Dental procedures	10.8 ± 3.0	14.9 ± 4.4	< .0001

* SBUH indicates Stony Brook University Hospital ambulatory setting; SDM, Stony Brook School of Dental Medicine; PMH, past medical history; HMO, health maintenance organization; and NS, not significant.

† Total facility cost at SDM: includes staffing and supplies (excluding professional fees for pediatric dentist and anesthesiologist)

‡ Total facility cost at SBUH: includes day admission, operating room fee, postanesthesia care unit services, staffing, and supplies (excluding professional fees for pediatric dentist and anesthesiologist); after adjusting for confounders, total cost savings = \$5471.

Incidence of dental procedures (restorations, pulpotomies, stainless steel crowns [SSC], and extractions) by location of patient treatment (Stony Brook University Hospital [SBUH] vs School of Dental Medicine [SDM]). Statistically significant differences were seen in restorations, pulpotomies, and SSC ($P < .05$).

at SBUH was 13.2 times greater than the cost at SDM. In addition, there were time savings for treatment at every stage of care at the SDM, including preoperative time, anesthesia time, and recovery time. The most significant time advantage was seen in the recovery time. Sending a patient to the postanesthesia care unit (PACU) after surgery, as is required at SBUH, added 2 hours to the recovery time versus the office-based setting at SDM. In addition, the PACU is an expensive form of care, with a 2-to-1 patient-to-nurse ratio.

While there was a difference in the number of dental procedures completed at the 2 sites, we hypothesize that this was a result of case selection. At the time of the study, ASA I patients were triaged to a venue based on the anticipated treatment, with longer cases being referred to the ambulatory hospital site. During the past year, our office-based setting at SDM has been handling longer and more involved cases because of the ability to intubate patients in this environment. In addition, although more procedures were done at SBUH, more restorations were completed at SDM. It seems possible that the provider mentality regarding the 2 locations plays a role in this difference. Often, the hospital is seen as the last resort, and as such, providers want to complete all treatment in a manner that does not require additional OR visits. Thus, if providers tend to be more aggressive with their treatment, we believe this would occur in the hospital setting.

Provider satisfaction was high at both locations, with pediatric dental residents believing that the office-based setting better prepares them for their career after residency. Interestingly, this appeal for office-based

anesthesia by pediatric dental residents parallels ideas reported in a study by Olabi et al, which found that newer American Board of Pediatric Dentistry members are more likely to use intravenous sedation and employ a DA and would use a DA if one were available.¹⁴ Anecdotally, the residents at our institution conveyed less parental anxiety, and possibly lower pediatric anxiety because of a child's greater level of comfort and familiarity with his surroundings, when the dental treatment was completed in an office-based setting as compared to the hospital. As reported by the providers, parents were extremely happy with care provided at both locations but appreciated the ease and convenience of the office-based setting, specifically arrival 30 minutes prior to treatment and the dramatically decreased recovery time.

GA for the pediatric population at the SDM was introduced following the creation of the DA residency training program at Stony Brook Medicine in 2008. Prior to the DA residency program, the waiting list for GA at SBUH was 8 months, as it was the only venue where GA services could be provided. Recently, we have found a change in appointment waiting time; the SDM is now overbooked and the hospital has shorter wait times. The waiting time for GA appointments at the SDM is 3 months longer than the waiting time at SBUH. It is our assumption that more parents are deciding that their children should receive GA at the SDM, since it is less costly when their insurance will not cover the anesthesia and facility fees associated with the hospital. We believe that cost and time factors play a significant role in parent and provider desires for office-based anesthesia at our institution.

In 1989, the American Academy of Pediatric Dentistry (AAPD) adopted a policy on third-party reimbursement of medical fees related to sedation/GA for delivery of oral health services:

The AAPD strongly believes that the dentist providing the oral health care for the patient determines the medical necessity of sedation/GA consistent with accepted guidelines on sedation and GA. The AAPD encourages third-party payors to: (1) recognize that sedation and/or GA is necessary to deliver compassionate, quality oral health care to some infants, children, adolescents, and persons with special health care needs; (2) include sedation, GA, and related facility services as benefits of health insurance without discrimination between the "medical" or "dental" nature of the procedure; (3) end arbitrary and unfair refusal of reimbursement for sedation, GA, and facility costs related to the delivery of oral health care.²

Despite the policy statement, dental cases with anesthesia are poorly reimbursed, with third-party payors denying benefits because they make the determination that the service is "not medically necessary."¹⁵

When payors refuse to cover the fees for GA or hospital facility fees, it is the parents who are primarily responsible for the economic burden associated with having their child receive dental treatment.¹ Even if Medicaid provides reimbursement, the hospital still loses money on long Medicaid dental cases because the ORs make money from high-turnover cases. Thus, when taking into account both the costs to the hospital and Medicaid-allowed charges, it is easy to understand why hospitals prefer cases that are not dental.

Nevertheless, it is important to note that certain cases require treatment in a hospital setting, eg, patients of very young age and/or very low weight; those who need extensive treatment (more involved dental work requiring an extended time under anesthesia, practitioner's desire for extended time in the PACU); patients with comorbidities; and children with ASA Class III or greater. However, at our institution, we should strive to treat as many ASA I patients that meet the criteria for our office-based setting (SDM). We can extrapolate our findings from this study and presume that it will also be time- and cost-effective to treat ASA II patients in our office-based setting.

In the future, we would like to expand our research to analyze a larger subset of patients. During the past year, SDM has increased the number of complex patients (ASA classes I–III) treated in the office-based setting because of the availability of additional resources and our ability to electively intubate patients. Therefore, continued studies incorporating ASA I, II, and III patients will be needed to determine whether the current findings will be the same for more medically challenging patients. In addition, we will want to evaluate canceled procedures, procedure completion rate, unplanned admissions, and safety.

CONCLUSION

Our present study and results with high significance demonstrate that office-based GA provided by DAs in ASA I preschool-age children is a viable option, in addition to being time- and cost-effective, associated with average adjusted cost savings of more than \$5000. The greatest cost savings when comparing anesthesia in the hospital versus in an office-based setting is the difference in the facility fee. As noted by Lalwani et al,¹⁶ performing GA in the office eliminates the OR charge. In their study, office-based dental rehabilitation using a pediatric sedation model in children with special needs achieved an average savings of nearly \$5000.¹⁶ Most important, the study by Lalwani et al, and our research findings presented in this paper both highlight the fact that patients with little or no access to care because of

financial reasons can receive dental care using GA in a time- and cost-effective manner in the office-based setting.

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