Analysis of patients planned for admission after dental treatment under general anesthesia.

Shannon Munsie

A thesis

Submitted in partial fulfillment of the requirements for the degree of

Master of Science in Dentistry

University of Washington

2018

Committee:

Barbara Sheller
Elizabeth Velan
Siri Kanmanthreddy

Program Authorized to Offer Degree:

Pediatric Dentistry

University of Washington

Abstract

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Shannon Munsie

Chair of the Supervisory Committee:

Barbara Sheller

Department of Dentistry

Purpose: To describe patients pre-planned for admission to hospital after dental treatment under general anesthesia (GA) and compare those who were subsequently admitted to a medical hospitalist to those discharged shortly after surgical completion.

Methods: Retrospective cohort study with review of electronic health records for patients planned for admission after dental treatment under GA between January 2015 and June 2017. Patients were excluded if the procedure was combined with another hospital service.

Results: Of the 156 children pre-planned for admission, 97 (62%) were subsequently admitted. Characteristics of children associated with postoperative hospital admission include chromosomal anomalies ($p=0.03$), trisomy 21 ($p<0.01$), and a trend towards patients with obstructive sleep apnea (OSA) not compliant with continuous positive airway pressure (CPAP) ($p=0.06$), and a rating of American Society of Anesthesiologists (ASA) class III ($p=0.07$). Airway concern was the most common reason for planned admission (n=115; 74%) and the most common reason for subsequent admission (n=72; 46%). Children planned for admission for

reasons of analgesia, nutrition or hydration were associated with admission ($p<0.01$). Apnea Hypopnea Index (AHI) was reported for 48 children and was not associated with admission. Body Mass Index (BMI) was not associated with admission. Significant differences in medical support provided to admitted patients versus discharged patients were: non-opiate analgesics ($p<0.01$), opiate analgesics ($p=0.02$), antiemetic ($p=0.01$), oxygen or airway support beyond typical post-operative care ($p=0.05$) and IV hydration ($p<0.01$).

Conclusion: Expected postoperative sequelae should be discussed with caregivers, including potential need for oxygen, IV hydration, nutrition, antiemetics and analgesics postoperatively prior to assigning a patient to a surgical venue or planning for hospital admission after dental surgery. Children with a high BMI may not necessarily require postoperative hospital admission.

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ACKNOWLEDGEMENTS

I would like to extend a sincere thank you to my committee members at Seattle Children's Hospital Department of Pediatric Dentistry and Department of Anesthesia for the encouragement and expertise with this project. You are outstanding leaders and role models for both research and compassionate patient care.

Introduction

For individuals with certain medical conditions and oral conditions, general anesthesia (GA) may be the only appropriate method to provide necessary dental treatment (AAPD, 2015). With increased availability and safety of GA there has been an increase in the number of patients who receive dental treatment under GA (Bohaty, Brenda; Spencer, 1992; Lee & Roberts 2003).

Patients receiving dental treatment under GA may experience adverse sequelae in the perioperative period (Rada, 2013). Common low-morbidity outcomes associated with GA include: pain, nausea, vomiting, and discomfort from intravenous line insertion (Marcario, Weinger, Truong, & Lee, 1999, Farsi 2009) . Other sequelae such as pain and oral bleeding result from the dental treatment performed (Holt, Chidiac, & Rule, 1991; Mayeda & Wilson, 2009; Cantekin, Yildirim, Delikan, & Çetin, 2014). Mild post-operative complaints such as pain, bleeding, and difficulty eating are common within the 24 hours following dental treatment under GA, though most children had no complaints after 72 hours in a study of 90 healthy children who received dental rehabilitation under GA (Farsi, Ba 'akdah, Boker, & Almushayt, 2009). A higher prevalence of perioperative complications and morbidity has been reported in patients with special health care needs (Enever, Nunn, & Sheehan, 2000).

Among the more serious sequelae following dental treatment under GA are: intractable post-operative vomiting, pain uncontrolled by oral medications, persistent post-operative oral bleeding, apneas, allergic reaction to medications or materials, seizures, or requirement of physiologic monitoring related to the patient's medical status (Mayeda & Wilson, 2009). Major complications and morbidity are most often associated with the provision of general anesthetic and the patient's medical status and uncommonly result from the dental treatment (Rada, 2013; Peretz, Spierer, Spierer, & Rakocz, 2012). When serious sequelae are anticipated due to either

patient factors or the nature of the planned dental treatment, admission to hospital after dental surgery should be considered.

It is important to identify patients who may require prolonged postoperative monitoring and medical support after dental treatment under GA. These patients may not be suitable for treatment in an outpatient/ambulatory surgery setting that is designed for short intervals between surgery and discharge to home.

A study at the University of Melbourne reported that 22 of 17,557 (0.7%) patients receiving dental treatment under GA between 2005-2009 in a day-stay surgery center required transfer by ambulance to a nearby hospital for management of perioperative complications after dental treatment (Verco, Bajurnow, Grubor, & Chandu, 2011). Seventeen of the 22 patients (77%) had medical comorbidities.

In a study of adult and child patients with special health care needs, 5 of 121 (4.1%) patients required post-operative hospitalization after dental treatment under GA (Peretz et al., 2012). All of the admissions were related to the patient's medical condition, rather than the dental treatment provided. Systemic diseases that were associated with hospitalization included: coagulation disturbances, intellectual disability, cerebral palsy, heart disease and cancer (Peretz et al., 2012). Relevant previous studies from 1974-2017 are summarized in Appendix A.

The Affordable Care Act has a Hospital Readmission Reduction Program (HRRP) which involves a penalty payment adjustment for patients who are readmitted, defined as an admission to hospital within 30 days of discharge from a hospital (Centers for Medicare and Medicaid Services, 2016). The penalty was 3% in 2015 (Clendennen et al., 2015). It is not known if the

HRRP affects the management of children with special health care needs following dental treatment under GA.

In a pilot study at Seattle Children's Hospital (SCH), approximately 10% of patients receiving dental treatment under GA were planned for admission postoperatively in the years 2008 through 2010. (Velan and Sheller, 2010). The duration of admission was 2.6-120 hours. Several patients who were planned for admission were discharged within four hours of surgery in the same manner as those patients who were not planned for admission. Most patients (53/67, 79%) were discharged within 24 hours. Data from the pilot study is summarized in Appendix B.

When day surgery patients are unable to be discharged following surgery, the medical team is challenged to make a priori care plan, as there may be no bed available, and the family arrangements for childcare, travel, and employment must be altered. At SCH, dentists planning treatment for patients under GA indicate if the patient is expected to be a day surgery or planned for same day admit.

The purpose of this study was to describe patients pre-planned for admission to hospital after dental treatment under GA and compare those who were subsequently admitted to the hospital to those discharged within 4 hours after surgical completion.

Methods

This retrospective cohort study examined data on patients up to age 21 years that received dental treatment under GA by pediatric dentists and pediatric dental residents at SCH between January 1, 2015 and June 30, 2017. Subjects were patients that were pre-

planned for admission to the hospital following dental treatment. Patients were excluded if the procedure was combined with another surgical or diagnostic service. Patients were screened for eligibility using electronic Pediatric Dentistry surgery logs from January 1, 2015 to June 30, 2017 and data was cross referenced with the SCH Department of Surgery registry of cases. Data was gathered from the patient's Electronic Medical Record (CIS), EPIC Hyperspace™, and a secure departmental drive. (Figure 1) This study was approved by the Seattle Children's Hospital Institutional review board (IRB ID: STUDY00000765).

All data was entered into a password protected REDCap database designed for the project. The variables collected included: sociodemographic, medical history, reason for planned admission, duration of procedure and hospitalization, dental treatment provided, intubation type and difficulty, and nature of medical treatment provided postoperatively (Appendix C). In the case of a significant medical comorbidity not listed, the category "other" was marked and the medical comorbidity was listed separately.

Variables were assessed and compared for patients who were admitted versus not admitted and for those who were discharged in greater than four hours versus less than four hours.

Data Analysis

Data was analyzed in R software. Descriptive statistics were calculated for all variables (counts and percentages for categorical variables, means and standard deviations for continuous variables), Fisher's Exact tests were conducted and p-values presented for categorical variables, and t-tests allowing for unequal variances were conducted and p-values presented for continuous variables. Statistical significance levels are each set to 0.05.

Results

Sample Characteristics: Tables 1 - 5

The total number of pediatric dentistry surgery cases between January 1, 2015 and June 30, 2017 was 1109: day surgery patients were 874 with 88 combination surgeries, admit patients were 235 with 63 combination surgeries. The number of stand alone pediatric dentistry cases were 948 and 156 patients were planned for admission (16%).

Of the 156 patients planned for admission, 97/156 (62%) were admitted to the medical hospitalist service following dental treatment under GA; 59 patients (38%) were discharged home directly from PACU. Of the 97 patients admitted, 26 did not stay overnight (27%) and 71 stayed in the hospital overnight (73%). None of the patients in this study were re-admitted to hospital due to complications of dental treatment or GA after discharge.

Only 14/156 (9%) of patients planned for admission were under 3 years of age with the largest age group planned for admission was between the age of 6-12 years (36%). The majority of the planned admits were male (57%), had public insurance (82%)

and lived relatively close to the hospital (58%). The stage of the dentition was expected given the age distribution of patients. There was no significant association between any demographic variable and being admitted after dental surgery (Table 1).

Nearly all subjects (154/156) had at least one medical comorbidity. Healthy children were planned for admission following dental surgery due to 1) a family history of airway angioedema following surgery and 2) a family history of malignant hyperthermia. Behavior issues (38%), congenital heart disease (27%) and reactive airway (28%) were the most common comorbidities. Those classified as "other" are listed in Appendix D. Trisomy 21 (100% admitted) and chromosomal anomalies other than trisomy 21 (p=0.03) were significantly associated with post-operative admission. Most comorbidities were not associated with admission following dental surgery. (Table 2; Figure 3)

The majority of patients planned for admission had a normal weight (48%). Body Mass Index (BMI) was not significantly associated with postoperative admission (p=0.80). (Table 3) Figure 4 shows that a higher percentage of normal weight children were planned for admission and admitted postoperatively compared to those in the underweight, overweight, and obese categories.

Seventy-two subjects (46%) had completed a sleep study prior to their dental surgery. The Apnea Hypopnea Index (AHI) was recorded from the sleep study if available (n=48) as well as if the child was recommended for CPAP and not compliant with CPAP. AHI was not associated with admission postoperatively (p=0.33) (Table 4; Figure 5). There was a trend towards patients with known OSA and not compliant with CPAP being admitted postoperatively (p=0.06).

The majority of patients planned for admission had an ASA classification of III (60%). While there was a trend towards ASA III patients being admitted to hospital following dental surgery (Figure 8), there was no significant association between ASA category and admission ($p=0.07$). There was an association between ASA and time from surgical completion to discharge > 4 hours. ASA III patients were more likely to spend > 4 hours from surgical completion to discharge ($p=0.035$). (Table 5; Figure 6).

Analgesia (22/23 patients; $p<0.01$), nutrition (26/28 patients; $p<0.01$) and hydration (16/16 patients; $p=0.01$) were reasons for planned admission that were significantly associated with being admitted after dental treatment (Table 6; Figure 7).

Although airway concern was the most common reason for planned admission (115/156; 74%) and many children with airway concerns were subsequently admitted (n=72; 62%) concern for airway was not significantly associated with being admitted post operatively ($p=0.85$). History of prolonged recovery following surgery, concern for control of bleeding, concern for postoperative behavior issues, greater distance between home and hospital, and social reasons such as living in a group home or homeless shelter, were not significantly associated with admission to hospital (Table 6).

Perioperative Factors Tables

Nasal intubation was most frequently done for dental patients (111/156; 71%). Patients with complex airways, concern for difficult intubation, history of cleft palate, and bleeding concerns received oral intubation. Five patients were anesthetized via their tracheostomy. One patient with severe epidermolysis bullosa was not intubated due to the short duration of procedure and risks of tissue damage with intubation. There was no association between type of intubation and postoperative admission (Table 7). The

anesthesia record indicates whether the intubation was difficult (yes/no). There were very few difficult intubations (n=13) and no significant association with being admitted after dental surgery (p=0.65). (Table 7)

There was no difference in the type or amount of dental treatment provided for patients admitted or not admitted. (Table 8). The mean number of both primary and permanent tooth extractions was higher in patients admitted to hospital, but these were not statistically significant (p=0.23 and p=0.26 respectively). Only 20 pulpotomies were performed in the 156 patients meeting inclusion criteria. Primary tooth extractions, stainless steel crowns and direct restorations (composite or amalgam) were the most common treatment provided in both groups. The average number of teeth treated was 9.1 in the cohort of patients admitted and 10.0 in the cohort of patients discharged home from PACU. (p=0.30).

No time parameters were statistically significant. (Table 9). The average duration of dental treatment was 106 minutes. This was similar for both cohorts as seen in Table 10. There was no difference in mean time of dental surgery (p=0.88), anesthesia time from time in the OR to surgical start (p=0.52) or in-room time to out-of-room time (p=0.52).

Postoperative Management

Table 10 compares postoperative medical treatment provided for ASA I, II, III and IV patients. Analgesics (both opiate and non-opiate) were most commonly provided to ASA II and III patients. Intravenous (IV) hydration was most commonly provided to those who were ASA III. Very few subjects were ASA IV (n=5) and 4 (80%) were

admitted to a medical hospitalist. Eighty-seven percent of patients planned for admission were discharged within 24 hours, regardless of ASA category. Most patients who were hospitalized for >24 hours after dental surgery were ASA III (19/24; 79%).

Significant differences in medical support provided to the admitted group versus those were discharged directly from PACU were: non-opiate analgesics ($p<0.01$), opiate analgesics ($p=0.02$), antiemetics ($p=0.01$), oxygen or CPAP use ($p=0.05$), and IV hydration ($p<0.01$) (Table 11; Figure 8).

Thirty-one patients planned for admission did not receive any medications postoperatively (20%). Twenty-nine of these 31 patients (94%) were not admitted ($p<0.01$) and were discharged within 4 hours of surgical completion. (Table 11)

Oxygen is typically given by blow by immediately after extubating; patients are then transitioned to room air in the post anesthesia care unit (PACU). No patient required re-intubation. Fifteen patients received oxygen beyond typical postoperative care or resumed the use of their CPAP. Of these patients, 13/15 were admitted to a medical hospitalist (87%). (Table 11)

Some patients required medications, treatments or specialty services not listed in Table 11. Twenty-two (96%) were admitted after dental surgery ($p<0.01$). Examples of other medical treatment provided include: warming (Bair Hugger^{TM}), humidified air, inhaled racemic epinephrine, nebulized albuterol, inhaled saline, ventilator titration test, acupuncture, mental health evaluation, social work consultation, IV anticonvulsant, prolonged blood pressure monitoring, abdominal MRI, admission to cardiology (3), pulmonology (1) and hematology-oncology (1).

Discussion

The system of pre-planning certain medically complex patients for hospital admission when this need could be anticipated following dental surgery was designed to benefit both families and providers. Prospective identification of patients for postoperative admission ensures there will be a bed available, allows the medical team responsible for post surgery medical support to review the patient's status and prepare for a smooth post surgery handoff, and helps families plan for an overnight stay. During times of high hospital census, elective surgery cases requiring postoperative admission may be cancelled due to the limited number of hospital beds.

During the time of the study, an unanticipated overnight admission was necessary for two of the 786 stand-alone pediatric dentistry day surgery patients. (0.2%), both patients had refractory emesis and were discharged within 24 hours. Of the 156 patients planned for admission, 97/156 (62%) were admitted and 71/97 (73%) stayed in the hospital at least overnight. Fifty-nine patients planned for admission were discharged home directly from PACU (38%). Of the 97 patients admitted, 26 did not stay overnight (27%).

The dentists planning treatment under GA for patients in this study were perhaps overly vigilant in identifying patients for post dental surgery admission, 38% of the patients recovered quickly enough to be discharged per the day surgery pathway. Our data provides only limited clues to discern how a given patient will fare post operatively. In analysis of patient characteristics, most comorbidities were not predictive of need for admission following dental surgery; only trisomy 21 and chromosomal anomalies were significantly associated with post surgery admission. The only reasons for planned admission that were significantly associated

with being admitted after dental treatment were anticipated challenge providing adequate post-operative analgesia (often manifesting as refusal to take oral medications), nutrition (manifesting as refusal to eat or drink) and need for intravenous hydration.

Conditions of chromosomal anomalies and trisomy 21 were significantly associated with postoperative admission. Syndromes are often associated with other medical comorbidities such as craniofacial anomalies and congenital heart disease, neither of which alone had a statistically significant association with being admitted to a medical hospitalist nor requiring prolonged postoperative care. This may suggest that children with syndromes who are likely to have multiple medical comorbidities are more likely to require prolonged post-operative care after dental treatment under GA. Patients with trisomy 21 who were planned for admission were all subsequently admitted to a medical hospitalist. It has been previously reported that children with trisomy 21 have increased complications with surgery for tonsil and adenoid removal (Lewanda et al., 2016). There may have been patients treated during this time with trisomy 21 who were not planned for hospital admission and subsequently discharged from PACU. Those children did not meet inclusion criteria for this study.

Morbid obesity and severe OSA are associated with increased peri-operative complications in adults, including airway obstruction, desaturation and cardiopulmonary incidents (Chung, 2010). A high BMI is associated with altered metabolism of medications. In a study of over 6000 children, high BMI was associated with increased perioperative complications after medical surgery (Nafiu et al., 2007). In a review of adults, if additional comorbidities are adjusted for, BMI alone was not associated with increased perioperative complications (Vasu et al., 2012). Many children with high BMI

are planned for admission postoperatively. BMI was not associated with hospitalization after dental surgery in this population.

Severity of AHI was not associated with admission in this study. Severe OSA in a pediatric population is defined as AHI >10. Only 12 patients in this study had an AHI >10. Severe OSA in adults with an AHI > 30 is associated with perioperative complications (Chung, 2010; Vasu et al., 2012). In a study of adults with severe obstructive sleep apnea, postoperative complications after outpatient surgery were suspected immediately postoperatively due to medications that decrease ventilation and increased obstructions. Complications from obstructive sleep apnea have also been reported to be increased postoperative days 2 to 5 due to REM sleep rebound (Vasu et al., 2012). Eighty-seven percent of patients in our study were discharged within 24 hours.

The nature of medical treatment provided postoperatively differs between patients admitted to hospital and those not admitted after dental rehabilitation. The type of dental treatment performed was not associated with postoperative admission. This is consistent with findings in the literature where perioperative complications are more likely related to the patient's medical status than to the treatment performed (Enever 2000; Holt 1991). It is well documented that children experience some pain after dental rehabilitation under GA (Cantekin 2014; Peretz 2012; Farsi 2009; Needleman 2009; Carter 2015; Mayeda 2009; Atan 2004; Enever 2000). One study showed that 95% of children experienced moderate pain. Another study noted that children with developmental delay were less likely to receive a postoperative analgesic than their typically developing peers (Conner, Musser, Colpitts, Laochamroonvorapongse, & Koh, 2017). Our study found that most patients in this medically complex patient population received postoperative analgesics.

Eighty-six percent (134 patients) received a non-opiate analgesic postoperatively. Twenty percent (33 patients) received an opiate analgesic postoperatively.

In a pilot study at SCH, the proportion of patients pre-planned for admission in 2008-2010 was 10% (74 patients) and 94% (67 patients) of those planned for admission were admitted. The proportion of patients planned for admission in 2015-2017 was: 21% (156 patients) and only 62% of patients planned for admission were subsequently admitted. Similar to the pilot study, most patients were discharged within 24 hours.

The Affordable Care Act Readmissions Reduction Program (HRRP) was implemented in 2012 and reduces payments to hospitals with excess readmissions. Premature discharge is often listed as a criterion leading to hospital readmission, which is costly and suggestive of poor patient care (Berenson 2012). There were no patients re-admitted within 30 days of surgery in the 2015-2017 study. It is not known the HRRP played a role in the increased proportion of patients planned for admission who are subsequently admitted between 2008-2010 and 2015-2017.

Limitations

Limitations of this study include the small sample size and the inability to compare patient characteristics to those patients not pre-planned for admission after dental surgery. It would have been valuable to record intra-operative and pre-operative medications and further details from the sleep studies including treatment recommended (i.e. CPAP vs surgery vs no treatment) or if subsequent surgery was performed to alleviate OSA symptoms prior to dental surgery. Parental preference to admission vs discharge was not recorded in this study.

Conclusion

Analysis of patients planned for admission after dental treatment under GA suggests that admission is multifactorial. Of children pre-planned for admission, children with trisomy 21 and other chromosome anomalies were associated with hospital admission postoperatively. Children planned for admission due to concern for inadequate nutrition, hydration or analgesia were associated with postoperative admission. Children who were admitted postoperatively more commonly received IV hydration, analgesics, antibiotics, antiemetics and oxygen beyond typical postoperative care. Children with a high BMI may not necessarily require hospital admission postoperatively.

Table 1: Sociodemographic characteristics of 156 children planned for admission to hospital following dental treatment under general anesthesia..

	Total **N = 156 (100%)** **N (%)**	**Admitted following dental surgery** **N = 97** **(62%)**	**Not admitted following dental surgery** **N = 59** **(38%)**	**p-value from Fisher's Exact**
Age				0.68
Under age 3 years	14 (9%)	8 (8%)	6 (10%)	
3-6 years	53 (34%)	30 (31%)	23 (39%)	
6-12 years	56 (36%)	37 (38%)	19 (32%)	
12+ years	33 (21%)	22 (23%)	11 (19%)	
Gender				0.87
Male	89 (57%)	56 (58%)	33 (56%)	
Female	67 (43%)	41 (42%)	26 (44%)	
Insurance Status				>0.99
Private	28 (18%)	17 (18%)	11 (19%)	
Public	128 (82%)	80 (82%)	48 (81%)	
Zip Code				>0.99
King, Pierce, Snohomish counties	90 (58%)	56 (58%)	34 (58%)	
Other	66 (42%)	41 (42%)	25 (42%)	
Stage of Dentition (N, %, p-value)				0.81
Primary	61 (39%)	36 (37%)	25 (42%)	
Mixed	63 (40%)	42 (42%)	22 (37%)	
Permanent	32 (21%)	20 (21%)	12 (20%)	

Table 2: Medical comorbidities of 156 children planned for admission to hospital following dental treatment under general anesthesia.

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	Total **N = 156 (100%)** **N (%)**	**Admitted following dental surgery** **N = 97 (62%)**	**Not admitted following dental surgery** **N = 59 (38%)**	**p-value from Fisher's Exact**
Medical Comorbidities				
Autism spectrum disorder	21 (13%)	15 (71%)	6 (29%)	0.47
Behavioral issues (other than autism)	60 (38%)	42 (70%)	18 (30%)	0.13
Cerebral palsy	14 (9%)	10 (71%)	4 (29%)	0.57
Cardiac anomalies	42 (27%)	27 (64%)	15 (36%)	0.85
Coagulopathies	10 (6%)	8 (80%)	2 (20%)	0.32
Craniofacial anomalies	35 (22%)	23 (65%)	12 (35%)	0.70
Diabetes mellitus	2 (1%)	1 (50%)	1 (50%)	>0.99
DiGeorge syndrome (22q11)	2 (1%)	1 (50%)	1 (50%)	>0.99
Hematologic conditions (excluding sickle cell)	6 (4%)	4 (67%)	2 (33%)	>0.99
Leukemia (excluding remission)	1 (1%)	1 (100%)	0 (0%)	NA
Metabolic conditions	2 (1%)	2 (100%)	0 (0%)	NA
Mitochondrial conditions	2 (1%)	1 (50%)	1 (50%)	>0.99
Musculoskeletal conditions	37 (24%)	24 (65%)	13 (35%)	0.85
Obstructive sleep apnea, not CPAP compliant	37 (24%)	28 (76%)	9 (34%)	0.06

Not applicable	6 (4%)	2 (33%)	4 (67%)	0.20
Oncology patients (excluding remission)	1 (1%)	1 (100%)	0 (0%)	NA
Other chromosomal anomaly	33 (21%)	26 (79%)	7 (21%)	0.03
Other endocrine conditions	17 (11%)	13 (76%)	4 (24%)	0.29
Other neurologic conditions	19 (12%)	11 (57%)	8 (43%)	0.80
Reactive airway	44 (28%)	29 (66%)	15 (34%)	0.59
Seizures (uncontrolled)	14 (9%)	8 (57%)	6 (43%)	0.78
Sickle cell disease	1 (1%)	0 (0%)	1 (100%)	NA
Spine at risk	6 (4%)	4 (67%)	2 (33%)	>0.99
Trisomy 21	17 (11%)	17 (100%)	0 (0%)	NA
Other significant medical comorbidity	35 (22%)	24 (69%)	11 (31%)	0.43

Table 3: Body Mass Index of 156 children planned for admission to hospital following dental treatment under general anesthesia: patients admitted versus not admitted

	Total **N = 156 (100%)** **N (%)**	**Admitted following dental surgery** **N = 97 (62%)**	**Not admitted following dental surgery** **N = 59 (38%)**	**p-value from Fisher's exact test**
BMI for Age				0.80
Underweight (<5th percentile)	18 (12%)	10 (10%)	8 (14%)	
Normal Weight (5th to 85th percentile)	75 (48%)	49 (51%)	26 (44%)	
Overweight (85th-95th percentile)	17 (11%)	11 (11%)	6 (10%)	
Obese (>95th percentile)	46 (29%)	27 (28%)	19 (32%)	

Table 4: Diagnosis of sleep apnea and AHI category for 156 children planned for admission to hospital following dental treatment under general anesthesia

	Total patients N = 156 (100%) N (%)	**Admitted following dental surgery N = 97 (62%)**	**Not admitted following dental surgery N = 59 (38%)**	**p-value**
Sleep apnea				
Sleep study done	72 (46%)	44 (45%)	28 (47%)	0.87
No diagnosis of sleep apnea	84 (54%)			
Average Apnea-hypoxia index (AHI), if reported, Mean (SD)	7.2 (8.6)	7.8 (7.9)	6.2 (9.8)	0.50
AHI, Categorized				0.33
AHI <5.0 (number, % of patients with sleep study done)	18 (12%)	10 (10%)	8 (14%)	
AHI 5.0-10.0 (number, % of patients with sleep study done)	18 (12%)	13 (13%)	5 (8%)	
AHI >10.0 (number, % of patients with sleep study done)	12 (8%)	10 (10%)	2 (3%)	

Table 5: Patients planned for admission following dental surgery who were admitted compared to those not admitted (discharged from PACU) by ASA. of 156 children planned for admission to hospital following dental treatment under general anesthesia

	Total **N = 156 (100%)** **N (%)**	**Admitted following dental surgery** **N = 97 (62%)**	**Not admitted following dental surgery** **N = 59 (38%)**	**p-value from Fisher's Exact**
ASA Classification				0.07
ASA 1	2 (1%)	1 (1%)	1 (2%)	
ASA 2	56 (36%)	28 (29%)	28 (47%)	
ASA 3	93 (60%)	64 (66%)	29 (49%)	
ASA 4	5 (3%)	4 (4%)	1 (2%)	
ASA Classification		**Discharged < 4 hours following dental surgery**	**Discharged > 4 hours following dental surgery**	0.035
ASA 1	2 (1%)	2 (2%)	0 (0%)	
ASA 2	56 (36%)	27 (28%)	29 (49%)	
ASA 3	93 (60%)	64 (66%)	29 (49%)	
ASA 4	5 (3%)	4 (4%)	1 (2%)	

Ta**ble 6:** Reason for planned admission for 156 children planned for admission to hospital following dental treatment under general anesthesia: patients who were admitted compared to those not admitted.

Reason for planned admission	**Total N = 156 (100%) N (%)**	**Admitted following dental surgery N = 97 (62%)**	**Not admitted following dental surgery N = 59 (38%)**	**p-value from Fisher's Exact**
Airway concerns	115 (74%)	72 (62%)	43 (38%)	0.85
Analgesia	23 (15%)	22 (96%)	1 (4%)	<0.01
Behavior	5 (3%)	4 (80%)	1 (20%)	0.65
Control of bleeding	6 (4%)	5 (83%)	1 (17%)	0.41
Distance from hospital	17 (11%)	10 (58%)	7 (42%)	0.79
History of prolonged recovery after surgery	31 (20%)	20 (65%)	11 (35%)	0.84
Hydration	16 (10%)	15 (94%)	1 (6%)	0.01
Nutrition	28 (18%)	26 (93%)	2 (7%)	<0.01
Social	10 (6%)	6 (60%)	4 (40%)	>0.99
Other	19 (12%)	9 (47%)	10 (53%)	0.21

Table 7: Type of intubation and difficult intubation for 156 patients planned for hospital admission following dental surgery

	Total N = 156(100%) N (%)	**Admitted following dental surgery N = 97 (62%)**	**Not admitted following dental surgery N = 59 (38%)**	**p-value from Fisher's Exact Test**
Type of intubation				0.65
Oral	38 (24%)	26 (27%)	12 (20%)	
Nasal	111 (71%)	66 (68%)	45 (76%)	
Other	7 (4%)	5 (5%)	2 (3%)	
Difficult intubation				0.77
Yes	13 (8%)	9 (9%)	4 (7%)	
No	142 (91%)	87 (90%)	55 (93%)	
Unknown	1 (1%)	1 (1%)	0 (0%)	

Table 8: Comparison of dental treatment for 156 patients planned for admission following dental surgery under general anesthesia: patients subsequently admitted vs not admitted following dental surgery.

Dental treatment	Total N = 156 (100%) N (%)	Admitted following dental surgery N = 97 (62%)	Not admitted following dental surgery N = 59 (38%)	p-value from t-test allowing unequal variance
Total teeth treated, Mean (SD)	9.4 (5.3)	9.1 (5.1)	10.0 (5.5)	0.30
Number of direct restorations (composite or amalgam), Mean (SD)	4.2 (4.4)	3.7 (3.6)	4.8 (5.5)	0.17
Number of SSCs, Mean (SD)	2.2 (2.7)	2.0 (2.6)	2.5 (2.9)	0.30
Number of primary teeth with pulp therapy, Mean (SD)	0.13 (0.52)	0.10 (0.42)	0.17 (0.65)	0.48
Number of endodontic procedures (permanent teeth), Mean (SD)	0.0064 (0.080)	0 (0)	0.017 (0.13)	0.32
Number of primary tooth extractions, Mean (SD)	2.8 (3.3)	3.0 (3.4)	2.5 (3.1)	0.40
Number of permanent tooth extractions, Mean (SD)	0.28 (0.98)	0.34 (1.1)	0.17 (0.65)	0.23
Number of surgical extractions, Mean (SD)	0.071 (0.34)	0.093 (0.38)	0.034 (0.26)	0.26
Periodontal surgery, Mean (SD)	0.058 (0.23)	0.052 (0.22)	0.068 (0.25)	0.69

Table 9: Duration of dental procedure, anesthesia time and time to discharge for 156 patients planned for hospital admission following dental treatment under general anesthesia: patients admitted vs patients not admitted.

Time	Total N = 156 (100%) N (%)	Admitted following dental surgery N = 97 (62%)	Not admitted following dental surgery N = 59 (38%)	p-value from t-test allowing unequal variances
Duration of surgery (surgical start to end), min, Mean (SD)	106 (51)	105 (48)	107 (57)	0.88
Duration in room time to out of room time, min, Mean (SD)	152 (56)	153 (55)	151 (59)	0.85
Anesthesia time (in-room time to surgery start time), min, Mean (SD)	32 (12)	33 (13)	32 (11)	0.52
Duration from surgical completion to discharge, min, Mean (SD)	769 (857)	1173 (865)	104 (52)	<0.01
Duration from out-of-room time to discharge, removing outliers, min, Mean (SD)	755 (858)	1159 (867)	91 (52)	<0.01

Table 10: Medical support provided and time from surgical completion to discharge vs ASA classification for 156 pediatric patients planned for admission following dental treatment under general anesthesia.

N (%) variable	ASA I N=2 1%	ASA II N=56 36%	ASA III N=93 60%	ASA IV N=5 3%
Post-operative medical treatment				
Amicar	0 (0%)	0 (0%)	2 (2%)	0 (0%)
IV non-opiate analgesic	0 (0%)	11 (20%)	22 (24%)	0 (0%)
IV opiate	1 (50%)	4 (7%)	14 (15%)	1 (20%)
IV Antibiotic	0 (0%)	0 (0%)	4 (4%)	1 (20%)
PO non-opiate analgesic	2 (100%)	33 (59%)	61 (66%)	0 (0%)
PO opiate	0 (0%)	3 (5%)	10 (11%)	0 (0%)
PO Antibiotic	0 (0%)	0 (0%)	2 (2%)	0 (0%)
Antiemetic	1 (50%)	5 (9%)	9 (10%)	1 (20%)
IV hydration	1 (50%)	13 (23%)	32 (34%)	3 (60%)
Time from surgery completion to discharge				
Under 4 hours	0 (0%)	29 (52%)	29 (31%)	1 (20%)
4-24 hours	2 (100%)	24 (43%)	46 (49%)	4 (80%)
>24 hours	0 (0%)	3 (5%)	18 (19%)	0 (0%)

Table 11: Nature of medical treatment provided postoperatively.

Postoperative medical treatment N = 156 (100%) N (%)	**Admitted following dental surgery N = 97 (62%)**	**Not admitted following dental surgery N = 59 (38%)**	**Total N = 157 (100%) N (%)**	**p-value from Fisher's Exact**
Transfer to PICU	1 (1%)	1 (100%)	0 (0%)	NA
Reintubation	0 (0%)	0 (0%)	0 (0%)	NA
Oxygen beyond typical postop or CPAP	15 (10%)	13 (87%)	2 (13%)	0.0498
Platelet transfusion	0 (0%)	0 (0%)	0 (0%)	NA
Clotting factor transfusion	1 (1%)	1 (100%)	0 (0%)	NA
Amicar	2 (1%)	2 (100%)	0 (0%)	NA
Tranexamic acid	0 (0%)	0 (0%)	0 (0%)	NA
IV NSAIDS/acetaminophen	33 (21%)	26 (79%)	7 (21%)	0.03
IV opiate	20 (13%)	14 (70%)	6 (30%)	0.62
PO NSAIDS/acetaminophen	101 (65%)	82 (81%)	19 (19%)	<0.01
PO opiate	13 (8%)	12 (92%)	1 (8%)	0.02
IV Antibiotic	2 (1%)	2 (100%)	0 (0%)	NA
PO Antibiotic	5 (3%)	5 (100%)	0 (0%)	NA
Antiemetic	16 (10%)	15 (94%)	1 (6%)	0.01
IV hydration	49 (31%)	49 (100%)	0 (0%)	NA
Special diet	7 (4%)	6 (86%)	1 (14%)	0.25
Other	23 (15%)	22 (96%)	1 (4%)	<0.01
None	31 (20%)	2 (6%)	29 (94%)	<0.01

Figure 1: Flow chart illustrating method of identifying patients for the study

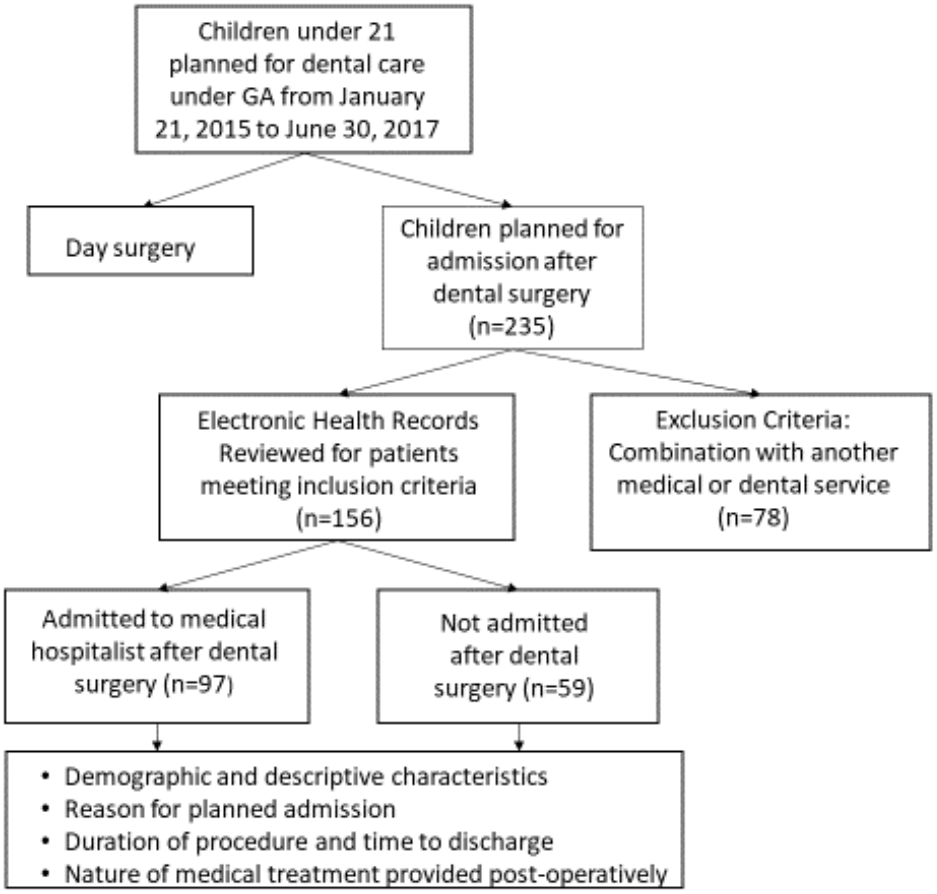


Figure 2: Bar graph of patients by age who were subsequently admitted to medical hospitalist (admit) vs discharged home from PACU (n=156). No statistical significance (p=0.68)

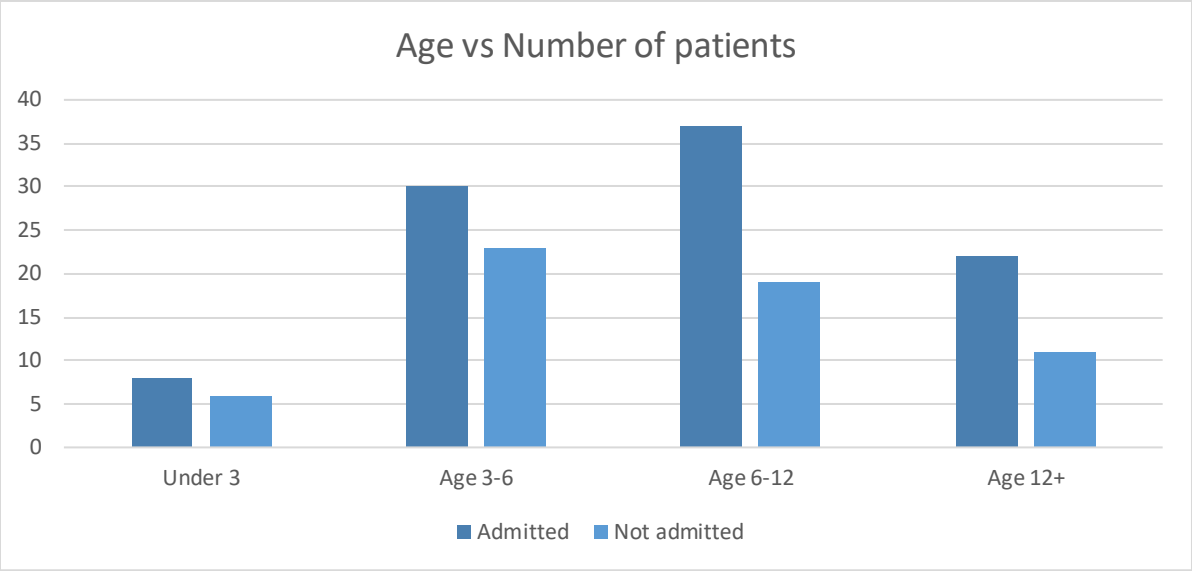


Figure *3*: Medical comorbidities of patients planned for admission and subsequently admitted vs discharged home from PACU

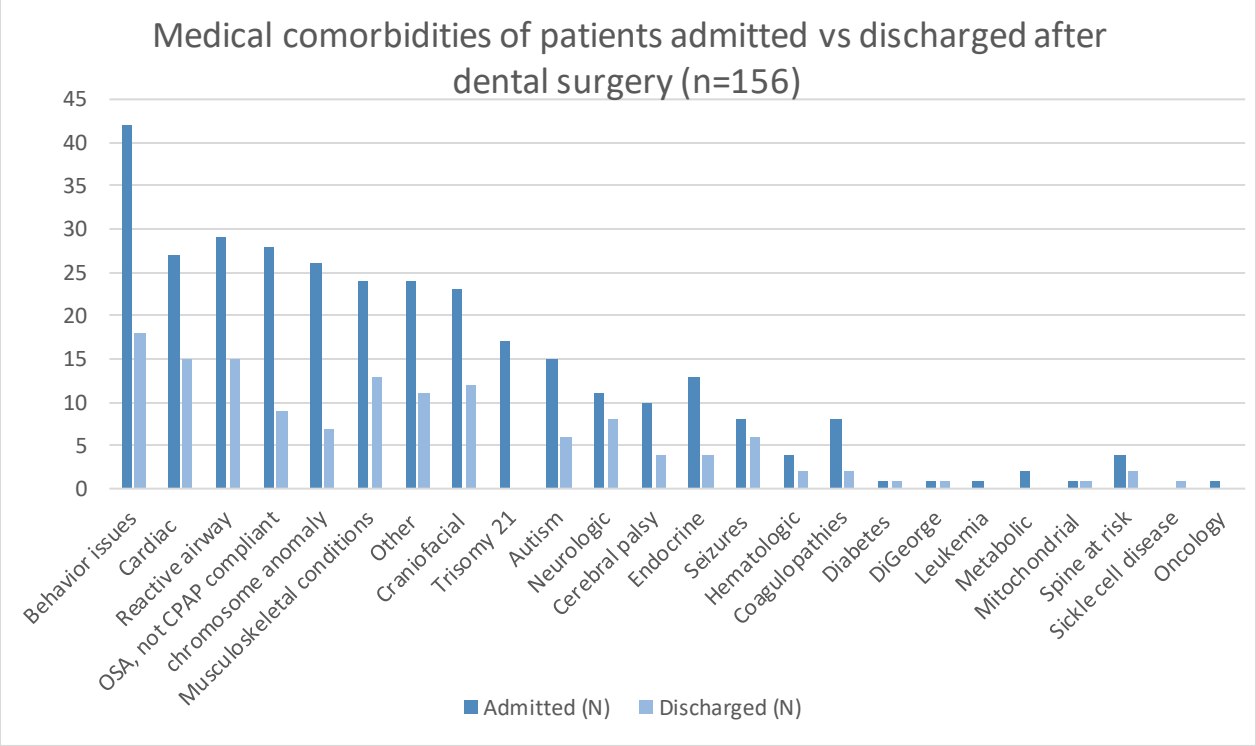


Figure 4: Bar graph showing patients admitted to medical hospitalist vs discharged from PACU based on BMI <5% (underweight), 5th to 85th percentiles (normal weight), 85th to 95th percentiles (overweight) and >95th percentile (obese). No statistical significance (p=0.80)

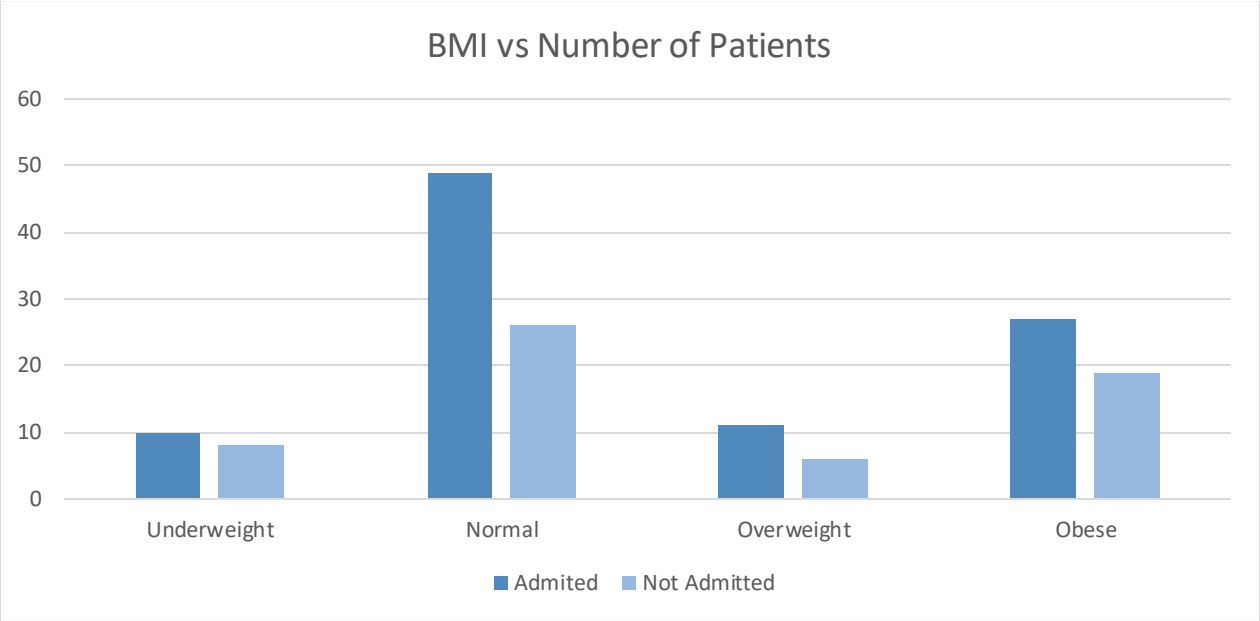


Figure 5: Bar graph showing number of patients admitted to medical hospitalist vs discharged home from PACU based on apnea hypopnea index (n=48). No statistical difference (p=0.33).

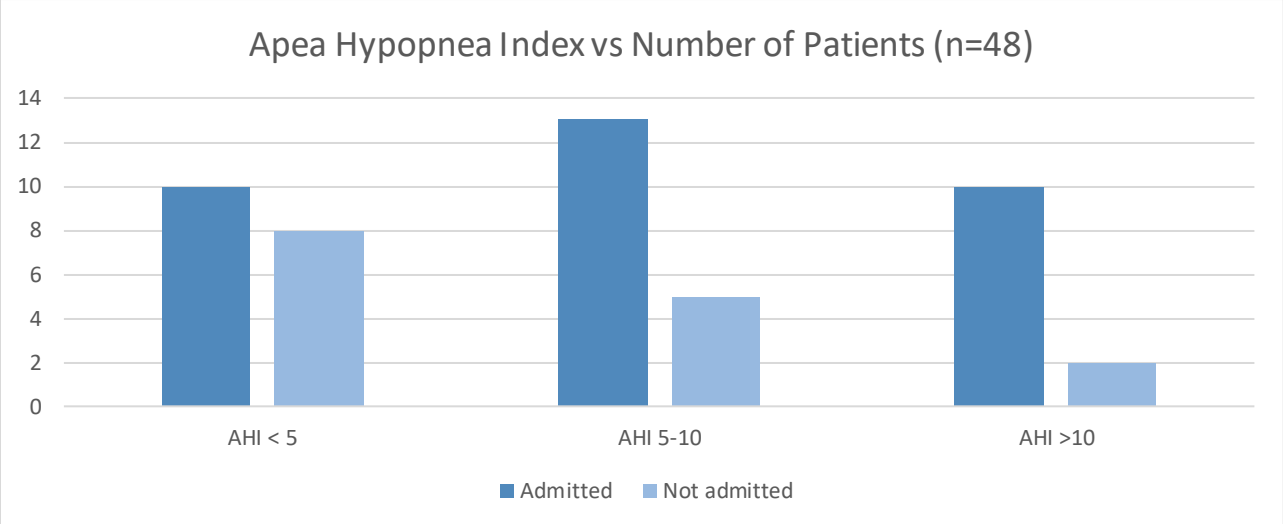


Figure 6: Bar graph of patients admitted following dental surgery vs discharged home from PACU by ASA (n=156). There is a trend towards ASA III being more likely to be admitted but it is not statistically significant (p=0.09)

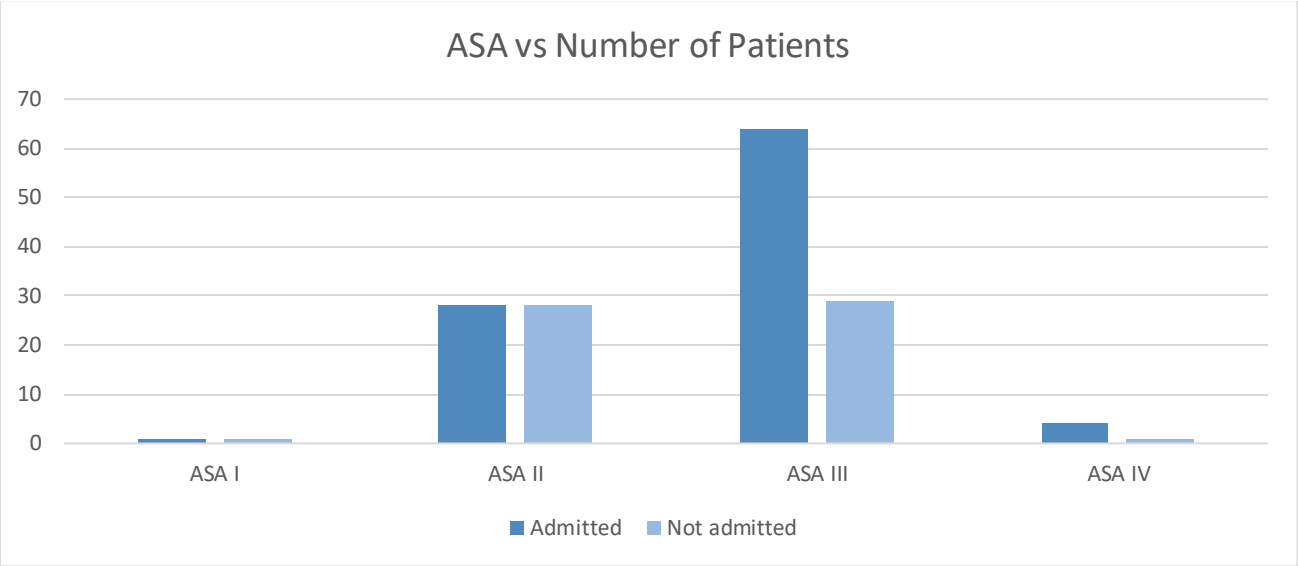


Figure 7: Bar graph of reason for planned admission vs Number of Patients.

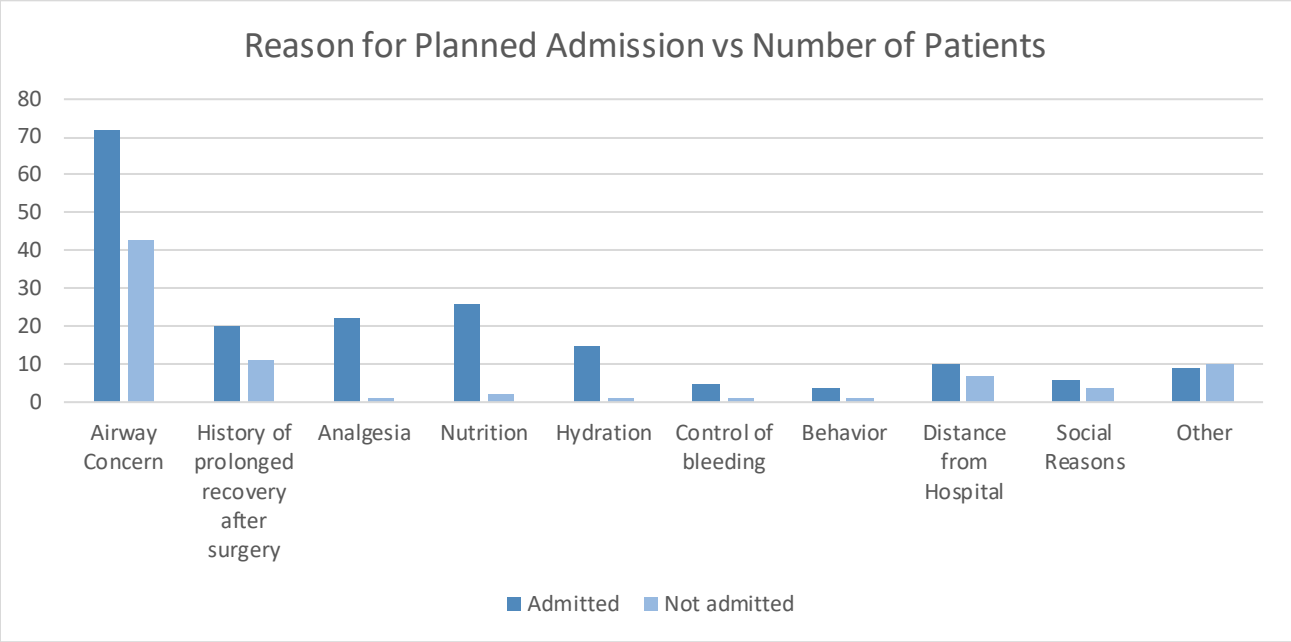
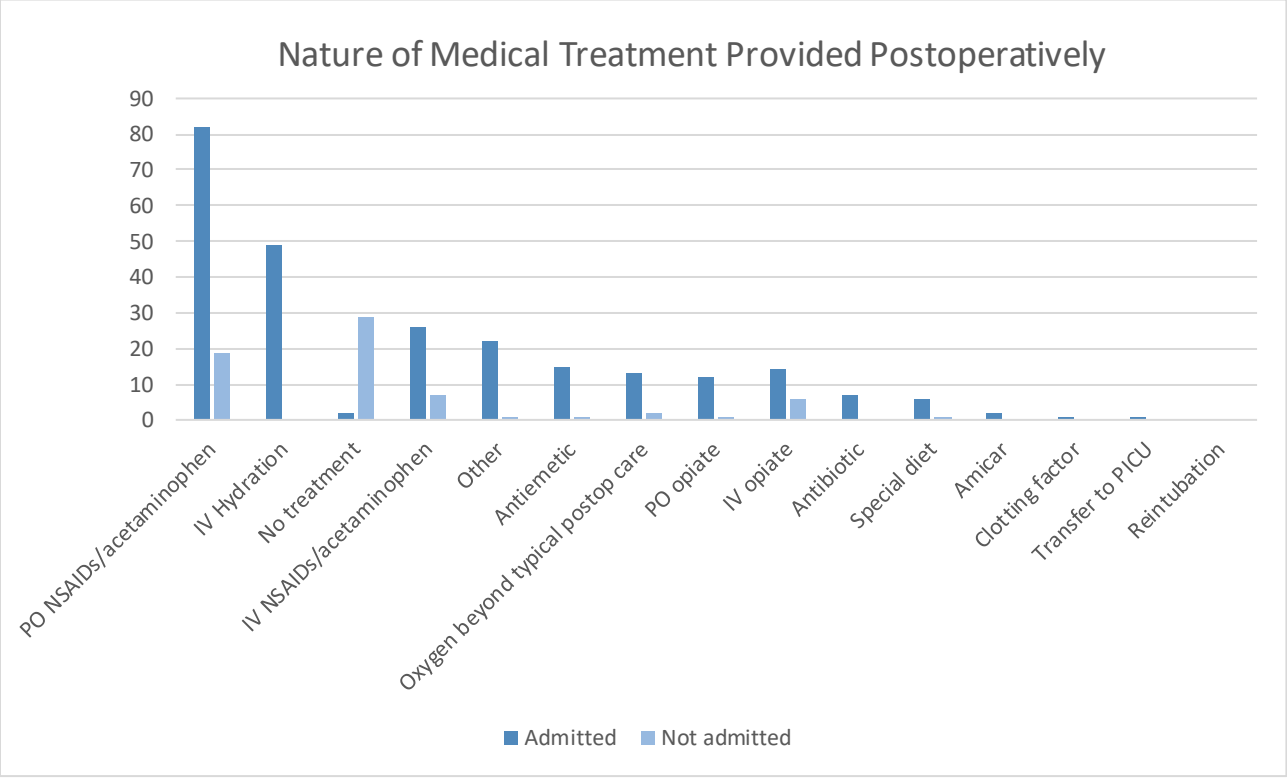


Figure 8: Nature of Medical Treatment Provided Postoperatively



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Appendix A:
Summary of literature regarding peri-operative complications and post-operative hospital admission for patients who received dental treatment under GA

Authors (year)	**Years included in study (Location)**	**Number of subjects**	**What was examined**	**Key findings**
(Arambula, Xie, & Whigham, 2018)	2014-2015 (Nashville, USA)	133 children with OSA	Identifying factors of children admitted to PICU after tonsil and adenoid removal.	• Patients under 2 and with significant medical comorbidity or a pre-op AHI >24 were more likely to require PICU • Other institutions refer children to PICU with severe OSA and other neurologic comorbidities, craniofacial anomalies, morbid obesity, respiratory failure, severe cyanotic congenital heart disease.
(Conner, Musser, Colpitts, Laochamroonvorapongse, & Koh, 2017)	2007-2012 (Oregon, USA)	1145 children	Post-operative nausea, vomiting and pain in children with developmental delay vs typically developing children after outpatient dental treatment under GA.	• No difference in post-operative nausea and vomiting. • No difference in post-operative agitation. • Children with developmental delay were significantly less likely to receive post-operative opiate regardless of whether one was given intra-operatively.
(Williams, & Story, 2015)	No data (Melbourne, AU)	Review of literature	Perioperative complications and management of children with autism spectrum disorder undergoing GA.	• Increased prevalence of children with ASD receiving GA. • Premedication common. • Recommended both non-pharmacological and pharmacological approaches

(Cantekin, Yildirim, Delikan, & Çetin, 2014)	no data (Turkey)	78 healthy 4-10 year olds	Post-operative interview after discharge or in PACU to assess post-operative discomfort	• Post-operative issues in 47/78 (59%). • 41% of patients had nasal discomfort • 33% throat discomfort • 43% mouth discomfort • Post-operative discomfort was related to the number of extractions (children with 4+ extractions were more likely to experience pain) • Nausea/vomiting in 20.5%
(Arnold et al., 2015)	2006-2011, Oregon, USA	121 children	Retrospective cohort study for patients with and without autism spectrum disorder undergoing GA for dental treatment. Compared premedication patterns, complications, pain, anesthetic type, PACU time and time to discharge.	• Difference noted in type and route of pre-medication in children with ASD • Intra-operative and post-operative period for children with ASD did not pose any special changes
(Ashley, PF; Williams & Parry, 2015)	Cochrane Systematic review, 1945-2015	18 studies	Comparing cost and morbidity of children up to age 18 undergoing dental treatment under GA vs IV sedation	• No randomized control trials • 18 related studies were found, none were found to be eligible • Cost of GA approximately 46% more • IV sedation not appropriate for complex treatment needs
(Rada, 2013)	2010-2012 (Chicago, USA)	50 patients	Retrospective study of patients with autism who had GA for dentistry in Hospital. Examined perioperative for patients ranging in	Complications in the peri-operative period: • Significant disruptive behaviors in the hospital (12%) • Post-operative vomiting delaying discharge (6%)

			age from 5 to 57 years old.	• Extensive post-operative bleeding due to patient pulling at surgical sites (4%) • Post-anesthesia rashes (4%) • Post-operative seizures requiring hospital admission (2%) • Ulcerated uvula from endotracheal tube trauma (1%)
(Peretz, Spierer, Spierer, & Rakocz, 2012)	2007-2009, (Sheba Medical Center, Isreal)	121 patients (ages 2-20)	Medical and dental records for 46 patients with systemic diseases and 75 patients with developmental disabilities aged 2–20 years, who had received dental treatment under GA). Age, gender, decayed missing and filled teeth (dmft/DMFT), dental procedures, duration of GA, and posttreatment hospitalization were recorded.	• Post-treatment hospitalization in this study was low: 5 subjects with systemic disease and 1 with developmental disability required further hospitalization • All admissions were due to their medical condition, not due to the anesthesia • Systemic disease that required hospitalization were: coagulation disturbances, intellectual disability, cerebral palsy, heart disease, cancer
(Verco, Bajurnow, Grubor, & Chandu, 2011)	2005-2009 (Melbourne, AU)	17 557 patients	Retrospective study of clinical incidents requiring transfer to another hospital and overnight stay for dental procedures under GA at a daycare surgery centre.	• 22 patients required hospital transfer and overnight stay • 17/22 patients transferred had medical comorbidities
(Carter, Wilson, & Tumer, 2010)	No data (Cincinnati, USA)	115 children (ASA I and II)	Descriptive study of perioperative analgesics associated with dental	• 80% administered analgesics pre-operative and intraoperatively • Fewer than 25% receiving postoperative analgesics

			rehabilitation under GA	• Procedure type, gender, health status not associated with number of agents given • Younger patients more likely to receive postoperative medication
(Mayeda & Wilson, 2009)	2008 (Ohio, USA)	50 children	Survey to assess adverse events in young, healthy children treated for dental caries under GA in the first 24 hours	• Common minor sequelae after GA are nausea, vomiting, prolonged sleepiness, pain, sore throat, swelling and bleeding
(Farsi N, 2009)	2008 (Saudi Arabia)	90 children (ASA I or II)	Questionnaire regarding post-operative patient complications immediately after, 1 day after and 3 days after dental rehabilitation under GA	• Most patient complications and complaints were within 24 hours of dental treatment under GA • There were very few patient complaints by day 3 • Patient complaints reported were noted as mild and included: inability to eat (85%), sleepiness (64%), bleeding (40%), pain (43%), sore throat (34%), vomiting (25%), psychological changes (24%), fever (21%), nausea (8%) within 24 hours of treatment
(Needleman , Howard; Harpavat, Sandhya; Wu, Sam; Allred, Elizabeth; Berde, 2009)	Years not reported, Boston, USA	90 children	Survey of parents of 90 healthy children who received dental rehabilitation under GA	• 95% of children had post-operative pain • Pain was moderate in intensity and most intense in PACU • No intra-operative LA used • Children who had extractions and were >4 years old had more pain. • Longer operative time resulted in increased post-operative sleepiness • Traumatic intubations resulted in sore throat • Those with emergence delirium received fentanyl and had increased nausea • All postoperative problems decreased significantly by day 2

				• Children undergoing GA experience pain, agitation, need for analgesics and sleepiness.
(Atan et al., 2004)	Data collected over 11 month period, year not noted (London, UK)	121 children	Study to assess what variables related to morbidity of child (ASA I and II) undergoing dental GA. Data collected by interviewing children pre-op, post-op and 4 times over the next 148 hours. Age range: 6-16	• Pain following GA was the most prevalent and long lasting symptom • 50% of children anxious prior to GA • Sleepiness reported 84% post-operatively • 21% complained of nausea • Morbidity related to GA was less of a problem than morbidity related to dentistry, as nausea and sleepiness decreased quickly
(Macario, Weinger, Truong, & Lee, 1999)	1998 (California, USA)	56 anesthesiologists	Survey of 56 anesthesiologists to assess clinical anesthesia outcomes associated with routine outpatient surgery.	• Survey identified pain, nausea, vomiting, pre-operative anxiety, and discomfort from IV insertion as common low-morbidity outcomes.
(Enever, Nunn, & Sheehan, 2000)	1996-1997 (Newcastle, UK)	55 children	Survey of morbidity after outpatient GA for dental treatment. Parents completed survey. Patient age ranged from 3-17.	• 27 intellectually or physically impaired patients, and 28 anxious dental phobic • 44% of caregivers reported symptoms, prevalence was similar in both groups • 20% report nausea and vomiting • 13% report need for analgesia at home • 1 person had to be admitted (persistent nausea and vomiting)

(Holt, Chidiac, & Rule, 1991)	1991 (London, UK)	103 children	Survey of post-operative morbidity after day-stay surgery for dental treatment under GA	• 94 patients had one or more symptoms following treatment. • In 53 cases, symptoms were related to the treatment and not the anesthetic.
(Enger, 1985)	1977-1982 (Virginia USA)	200 children	Study evaluates complications that occur most often after the administration of GA: nausea, vomiting, fever, sore throat, pharyngitis, lip swelling, delayed recovery. Patients included 54% ASA 1, 40% ASA 2, 7% ASA 3	• No statistical significance between patient's pre-operative physical status and complications postoperatively.
(Leagault, Diner, & Auger, 1972)	Prior to 1972 (4 year duration – years not noted, Montreal, Canada)	300 children	Evaluated occurrence of unforeseen complications, the necessity of further treatment under GA and the elapsed time between the initial and any subsequent dental treatment.	Evolution of pediatric dental GA: Parent administered barbiturate premedication at home has been replaced with administration of short acting benzodiazepines immediately prior to induction • Treatment includes more restorative and preventive procedures and fewer extractions, and Average post-operative stay has decreased from greater than two days in-hospital to a few hours

Appendix B: Summary of data from pilot study of patients planned for admission after dental treatment under GA from 2008-2010

Authors (year)	**Years (Location)**	**Subjects**	**What was examined**	**Outcome of study**
Velan E, Sheller B (2010)	2008-2010 (Seattle, USA)	748 patients seen under GA	Children who received dental treatment under GA. Data included: demographics, medical diagnosis, American Society of Anesthesiologists (ASA) Classification, gender, age, number of restorations and extractions, and details of other surgical or diagnostic services provided under the same GA. Data regarding admission included length of stay, medical interventions and post-surgical complications.	• 28% ASA I (211/748), 44% ASA II (327/748), 26% ASA III (194/748), 2% ASA IV (16/748). • 10% of patients planned for admission after GA • 3% ASA II (11/327), 30% ASA III (58/194), 31% ASA IV (5/16) • Age differed between ASA groups • Treatment provided did not differ between ASA II and III • Surgery time did not differ by ASA • All patients had multiple co-occurring medical diagnosis • Of 74 patients planned for admission, 2 ASA II and 5 ASA III patients did not require admission16 • Admission time ranged from 2.6 to 120 hours • Most patients (79%) were discharged within 24 hours • 10/14 patients admitted longer than 24 hours were discharged by 28 hours • Both ASA 3 and ASA IV patients had significantly longer time to discharge than ASA 2 • No correlation between total surgery time to discharge, type of dental treatment to discharge, extent of dental treatment to discharge or combination surgery and time to discharge • Post-operative sequelae for admitted patients included pain management, low oxygen saturation (15/67), combative behavior (5/67), emesis (2/67) • Reasons for admission longer than 28 hours include: intraoperative complication, respiratory difficulties, pain

Appendix C: Comprehensive list of variables collected:

- Patient's date of birth: mm/dd/yyyy
- Insurance status: public/Medicaid, private, none
- Patient's ZIP code
- Patient's gender: male, female.
- Date of dental surgery: mm/dd/yyyy
- Weight: kilograms
- American Society of Anesthesiologists (ASA) physical status: I, II, III, IV as recorded on anesthesia records
- Body Mass Index
- Sleep study performed
- Sleep study apnea-hypoxia index
- Medical comorbidities:
    - trisomy 21
    - DiGeorge syndrome (22q11)
    - other chromosomal anomaly
    - obstructive sleep apnea and patient not compliant with CPAP
    - spine at risk
    - reactive airway,
    - craniofacial anomalies,
    - cardiac anomalies (excluding benign murmurs and spontaneously closed atrial septal defects and ventricular septal defects)
    - neurologic conditions,
    - Seizures (uncontrolled)
    - musculoskeletal conditions,
    - endocrine conditions,
    - diabetes
    - mitochondrial conditions
    - metabolic conditions
    - hematologic conditions,
    - coagulopathies
    - sickle cell disease
    - oncology patients,
    - leukemia
    - autism spectrum disorder
    - behavioral issues other than autism spectrum
- Reason for planned admission
    - History of previous prolonged recovery after surgery
    - Analgesia
    - Airway

    - Nutrition
    - Hydration
    - Control of bleeding
    - Patient behavior
    - Distance from hospital
    - Social reasons
    - Other
- Duration of dental surgery procedure
    - Surgery start time
    - Surgery end time
    - In room time
    - Out of room time
    - Date and time of admission
    - Date and time of surgical completion
    - Date and time of hospital discharge
- Stage of dentition
    - Primary
    - Mixed
    - Permanent
- Treatment type:
    - Number of teeth
    - Number of direct restorations (composite or amalgams)
    - Number of stainless steel crowns
    - Number of primary teeth with pulp therapy
    - Number of endodontic procedures (permanent teeth)
    - Number of primary tooth extractions
    - Number of permanent tooth extractions
    - Number of surgical extractions
    - Periodontal surgery
- Intubation
    - Nasotracheal
    - Orotracheal
    - Other (tracheostomy, no intubation)
    - Number of intubation attempts
    - Difficult intubation (yes/no)
- Duration of admission
    - Date and time of admission (pre-operatively)
    - Date and time surgery finish
    - Date and time hospital discharge
- Nature of medical treatment provided during admission

- Transfer to PICU
- Oxygen
- Reintubation
- Platelet transfusion
- Clotting factor infusion
- Amicar
- Transexcemic acid
- IV NSAIDS/acetaminophen
- IV opiate
- PO NSAID/acetaminophen
- PO opiate
- IV Antibiotic
- Oral antibiotic
- Antiemetic
- IV hydration
- Special diet
- Other

Appendix D: List of other significant medical comorbidities not included in check-boxes.

- Cystic Fibrosis
- Epidermolysis bullosa
- Restrictive lung disease
- Interstitial lung disease
- Tracheomalacia
- Primary ciliary dyskinesia
- Complications of heart transplant
- Complications of kidney transplant
- Family history of malignant hyperthermia (MH)
- Family history of airway swelling after GA
- History of anaphylaxis with GA in an out-patient setting and required an ambulance to the ED
- Fibrous dysplasia ossificans progressiva
- Loeys-Dietz syndrome with history of multiple aneurysms
- AADC deficiency
- Pierre Robin Sequence (7 patients)
- Treacher Collins
- Tuberous sclerosis
- Spherycytosis
- Hypertension
- Myotonic dystrophy
- Obesity

Appendix E: Patients who received oxygen beyond typical postoperative care or CPAP after dental treatment under GA.

1. 11 year old with trisomy 21, OSA, CPAP compliant and had full facemask overnight.
2. 20 year with cerebral palsy, OSA, BiPAP compliant and used BiPAP overnight.
3. 6 year old with Pierre Robin Sequence, obesity, severe OSA, CPAP compliant and used CPAP overnight
4. 14 year old with autism who transitioned to room air, then had blow-by oxygen again.
5. 2 year with repaired cleft lip and palate transitioned to room air, then had blow-by >1hr later
6. 9 year old with cerebral palsy, OSA, BiPAP compliant had full facemask overnight.
7. 6 year old congenital heart disease prior to fontan, had oropharyngeal airway in place in PACU, spO2 80-81% baseline, oxygen presumed but not recorded in flowsheets or chart notes. She was discharged the same day, but stayed in PACU >4 hours.
8. 9 year old female with Apert Syndrome, CPAP compliant and used CPAP overnight.
9. 8 year old male with autism, asthma, OSA and CPAP compliant. Received oxygen via nasal pillows overnight.
10. 11 year old with trisomy 21, obesity, sickle cell trait, BiPAP compliant and received humidified air + oxygen via nasal mask.
11. 3 year old male with muscular dystrophy who received oxygen by blow-by venti-mask approximately 4 hours after transitioned to room air.
12. 3 year old male with trisomy 21, obesity, chronic lung disease, not complaint with CPAP and received nasal cannula oxygen for 1 hour postoperatively.
13. 14 year old male with cri du chat syndrome. He received blow by oxygen 40 minutes after transitioned to room air, then 'simple mask' used, then transitioned back to room air.
14. 17 year old male with complex heart disease and artificial valve, anti-coagulated, loeys-dietz syndrome. He received oxygen by nasal cannula for ~2 hours postoperatively.
15. 14 year old male with anoxic brain injury, global developmental delay, cyclic neutropenia, intractable epilepsy with vagal nerve stimulator, dysphagia and G-Tube. He required BiPAP over night and typically tolerates BiPAP for 1-2 hours at home.