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Trends in Outcomes and Variation by Race and Ethnicity in Pediatric Plastic Surgery in the United States

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Background: The American College of Surgeons' National Surgical Quality Improvement Project-Pediatric Data manages a multicenter dataset for monitoring outcomes in pediatric surgical care. We explored trends in outcomes in the most frequently sampled current procedural terminology codes related to craniofacial and cleft lip and palate (CLP) surgical procedures over a 7-year period.

Methods: We used National Surgical Quality Improvement Project-Pediatric Data on 28,147 pediatric patients who underwent plastic surgical procedures between January 1, 2012, and December 31, 2018. Eighteen relevant current procedural terminology codes were selected and sorted into two procedure groups: CLP and craniofacial. For each group, we explored trends in readmission, reoperation, extended length of stay, morbidity, and racial and ethnic variation.

Results: The proportion of readmissions following CLP repair saw a significant reduction per year (from 3.6% to 1.7%). African American or Black CLP patients had significantly higher rates of readmission and extended length of stay when compared to the overall cohort. Asian and White CLP patients had significantly lower rates of experiencing an extended length of stay. For craniofacial cases, extended length of stay decreased significantly per year (from 7.7% to 2.8%). One possible driver of this change was a decrease in transfusion rates during the study period from 59% to 47%.

Conclusions: Pediatric CLP and craniofacial cases saw significant improvements in safety, as indicated by reductions in readmission and extended length of stay. Given the racial differences observed, especially among CLP patients, continued research to identify and address systems of racism in health care remains a priority.
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INTRODUCTION

Since 2016, health care spending in the United States has continued to grow at a consistent rate of 4.5%, projecting an average annual growth rate of 5.4% for 2019 through 2028.[1] While the national health expenditure increases, the Institute for Healthcare Improvement (IHI) has called on institutions to improve the quality of their care to combat potential areas of inefficiency and rising health care costs.[2] The need has arisen to develop meaningful ways for institutions to track patient outcomes. One such database to address this need is the American College of Surgeons (ACS) National Surgical Quality Improvement Project-Pediatric Data (NSQIP-P), which collects surgical outcomes in children and provides participating sites with yearly sampling of its data.

NSQIP-P has created an opportunity to study nationwide, longitudinal outcomes in pediatric surgical care. This study aimed to identify gaps and opportunities for improvement in patient outcomes in pediatric plastic surgery. We explored variation over time across two plastic surgical procedural categories at participating hospitals between 2012 and 2018, with a particular interest in variation across race and ethnicity.

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METHODS

The ACS NSQIP-P provides participating institutions with the ability to track trends in surgical outcomes. More than 127 participating hospitals provided 28,147 cases for review for the time period of this study.[3,4]

Data Source

This study examined demographics and postoperative outcomes in pediatric patients (age less than 18 years) who underwent a plastic surgical procedure at a participating NSQIP-P site between January 1, 2012, and December 31, 2018. NSQIP-P data collection methods have been summarized previously.[5–9] Participating sites collect and submit data to NSQIP-P for 35 cases or procedures over an 8-day cycle. NSQIP-P provides each site with a list of targeted procedures or "core variables" to capture less common current procedural terminology (CPT). These core variables change yearly; however, the CPT codes utilized in this analysis remained consistent for the study period.[4] NSQIP-P collects over 20 core variables for postoperative morbidities. Outcomes are self-reported by each institution and collected through reviews of patients' electronic or paper records, documented follow-up visits, and morbidity and mortality conferences. All cases must have a 30-day follow-up to be included in the dataset.[3] NSQIP-P utilizes a three-tiered CPT system for sites to select cases for sampling. Each site selects cases from the first tier and then moves to cases in the second, then the third tier as necessary until the weekly 35-case count is reached.

Measures

Eighteen CPT codes relevant to pediatric craniofacial and cleft lip and palate (CLP) plastic surgical procedures were selected and reviewed by a group of pediatric plastic surgeons, but NSIQP-P consistently sampled these CPT codes over the entirety of the 7-year study period. The selected codes were then sorted into two distinct procedural groups based on the anatomical location of the procedure: CLP and craniofacial. (**See Tables, Supplemental Digital Content 1**, which describes list of CPT codes by procedural group, **http://links.lww.com/PRSGO/C391**.) Both procedure groups had CPT codes that were listed in the second tier of the NSQIP sampling process.

The following NSQIP-P variables were included in the analyses: reoperation, readmission, and length of stay. In addition, 30-day morbidity was derived for each case using the total number of complications experienced within the first 30 days following the procedure. These complications included pneumonia, renal failure, sepsis, prolonged ventilation, urinary tract infection, transfusion, surgical site infection, central line-associated bloodstream infection, dehiscence, seizure, death, or cardiac arrest. NSIQIP-P defines length of stay as the number of days a patient was admitted following their procedure, not including any readmission. Length of stay was dichotomized by CPT grouping those that were clinically typical or those that were extended. These extended length-of-stay cutoff points were estimated by the senior author (A.H.T.) and were used to minimize the influence of statistical outliers (few severe patients with very long hospitalizations) when assessing changes in length of stay throughout the study period. Hospitalizations were deemed extended as per the following clinically typical benchmarks: CLP (≥3 days) and craniofacial (≥7 days).

NSQIP-P reports race utilizing the following classifications: White, Black or African American, Asian, American Indian or Alaska Native, Native Hawaiian or other Pacific Islander, and unknown/not reported. Due to limited sample size among certain racial classifications, the following were collapsed into a single classification: American Indian or Alaskan Native and Native Hawaiian or other Pacific Islander. Additionally, NSQIP-P reports information regarding Hispanic ethnicity status.

Statistics

The procedure groups were analyzed separately. Frequency distributions were tabulated for all variables and CPT groups. The Pearson χ^2 and Fisher exact tests were used to compare outcomes by CPT grouping. To explore variation in the reoperations, readmissions, length of stay, and morbidity outcomes over time, we used a negative binomial regression for each procedure group, with the number of events per patient as the outcome measure and year of procedure as the continuous, explanatory variable. To explore variation in outcomes across race and ethnicity, we added a categorical term for race to the regression models to assess for statistical significance. An offset variable was calculated by taking the natural log of the number of cases to account for the varying observation periods, with a fixed regression coefficient of 1. Rates are reported with corresponding 95% confidence intervals using the exact binomial method. Statistical analyses were conducted using SPSS (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, N.Y.: IBM Corp.). Statistical significance was defined as P less than 0.05.

Takeaways

Question: Have outcomes in pediatric plastic surgery shown a trend toward improvement?

Findings: Over a 7-year period ending in 2018, there was a significant reduction in readmissions and extended length of stay for cleft lip and palate and craniofacial procedures; however, significant racial disparities were noted.

Meaning: Our results provide evidence of improvement in the safety of major pediatric plastic surgical cases while emphasizing the necessity for addressing racial disparities.

RESULTS

Data were obtained on a sample of 28,147 cases over the 7-year study period. Over this time, the number of participating institutions increased from 50 to 127. The median age at time of surgery for all cases was 1.1 years (interquartile range, 4.7). Of note, 8.5% (n = 2380) of all sampled cases experienced a complication during the study period. CLP cases far outnumbered other cases

(N = 25,072), mainly because NSQIP-P sampled CLP CPT codes at a more consistent rate than the other procedure groups (12 CLP CPT codes versus six craniofacial CPT codes). (**See Tables, Supplemental Digital Content 1**, **http://links.lww.com/PRSGO/C391**.)

Cleft Lip and Palate

From 2012 to 2018, there were 25,072 CLP cases reported to NSQIP-P. In total, 472 complications were reported at a rate of 1.9 per 100, commonly experiencing dehiscence (n = 195, 0.8%), prolonged ventilation (n = 71, 0.3%), or superficial wound infection (n = 65, 0.3%). (**See figure, Supplemental Digital Content 2,** which shows a table that lists morbidity measure incidence rates by race in the CLP cohort, **http://links.lww.com/PRSGO/C392**; **see figure, Supplemental Digital Content 3**, which shows a table that lists morbidity measure incidence rates by ethnicity in the CLP cohort, **http://links.lww.com/PRSGO/C393**.) The proportion of reoperations, extended lengths of stay, and the overall morbidity rate per year remained stable over the study period ($P > 0.05$, all; Table 1; Figs. 1–3). However, there was a significant reduction in readmissions per year (IRR, 0.88; 95% CI, 0.85–0.92; $P < 0.001$; Table 1). The proportion of readmitted patients dropped significantly from 3.4% (95% CI, 2.8–4.2) in 2012 to 1.7% (95% CI, 1.4–2.1) in 2018 ($P < 0.001$; Fig. 4).

Regression analysis found significant variation across race and ethnicity groups in readmission ($P < 0.05$; Table 2) and extended length of stay ($P < 0.05$; Table 3). African American or Black patients had significantly higher rates of readmission (IRR, 1.37; 95% CI, 1.08–1.76; $P = 0.03$; Table 2; Fig. 5) and extended length of stay (IRR, 1.23; 95% CI, 1.07–1.40; $P = 0.006$; Table 2; Fig. 5) when compared to the overall cohort. Conversely, Asian (IRR, 0.85; 95% CI, 0.72–0.98; $P = 0.03$; Table 2; Fig. 5) and White patients (IRR, 0.95; 95% CI, 0.90–0.99; $P = 0.03$; Table 2; Fig. 5) had significantly lower rates of experiencing an extended length of stay postoperatively.

Craniofacial

During the study period, 3075 craniofacial cases were reported to NSQIP-P with 1,908 complications (rate of 62.0 per 100). The most commonly reported complications were transfusion (n = 1764, 57%), followed by superficial wound infection (n = 36, 1%). (**See figure, Supplemental Digital Content 4**, which shows a table that lists morbidity measure incidence rates by race in the craniofacial cohort, **http://links.lww.com/PRSGO/C394**; **see figure**, **Supplemental Digital Content 5,** which shows a table that lists morbidity measure incidence rates by ethnicity in the craniofacial cohort, **http://links.lww.com/PRSGO/C395**.) There was no significant change in the proportion of reoperations and readmissions ($P > 0.05$, both; Table 1; Figs. 1, 4). The proportion of patients who had an extended length of stay reduced significantly per year over the study period (IRR, 0.90; 95% CI, 0.83–0.97; $P = 0.009$; Table 1), equivalent to a reduction from 7.4% (95% CI, 4.9–10.7) to 2.8% (95% CI, 1.4–4.9). Although there was no significant decrease in overall 30-day morbidity, there was a significant decrease in the proportion

Table 1. Negative Binomial Regression Results Examining Variations in Outcomes by Procedure Group

		Reoperations			Readmissions			Extended Length of Stay			Morbidity		
Procedure Group	**Measure**	**IRR**	**95% CI**	***P***	**IRR**	**95% CI**	***P***	**IRR**	**95% CI**	***P***	**IRR**	**95% CI**	***P***
Cleft lip and palate	Constant	0.75	(0.56–1)	<0.001	3.63	(3.15–4.19)	<0.001	91.35	(83.39–100.08)	<0.001	1.94	(1.62–2.33)	<0.001
	Change in rate by year	1.02	(0.95–1.09)	0.635	**0.88**	**(0.85–0.92)**	**<0.001**	0.99	(0.97–1.01)	0.31	0.99	(0.95–1.04)	0.687
Craniofacial	Constant	2.97	(2–4.4)	<0.001	3.68	(2.56–5.27)	<0.001	76.58	(58.15–100.85)	<0.001	66.03	(60.74–71.77)	<0.001
	Change in rate by year	1	(0.89–1.11)	0.932	0.98	(0.88–1.08)	0.639	**0.9**	**(0.83–0.97)**	**0.009**	0.98	(0.96–1.003)	0.085

Values in boldface are statistically significant.

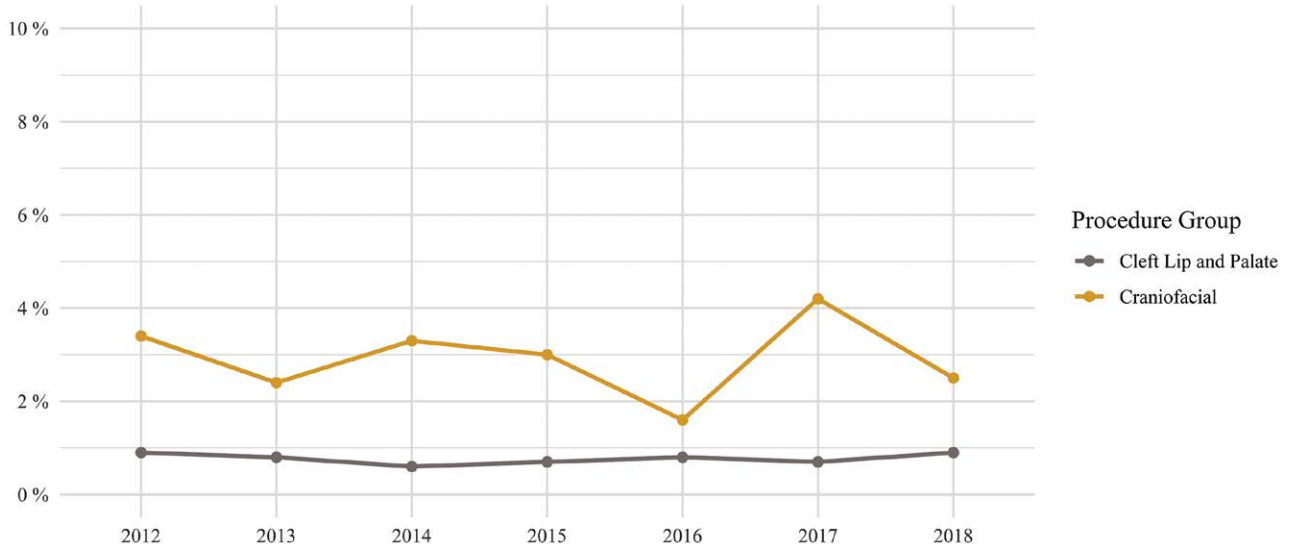

Fig. 1. Change in rate of reoperations for each procedure group.

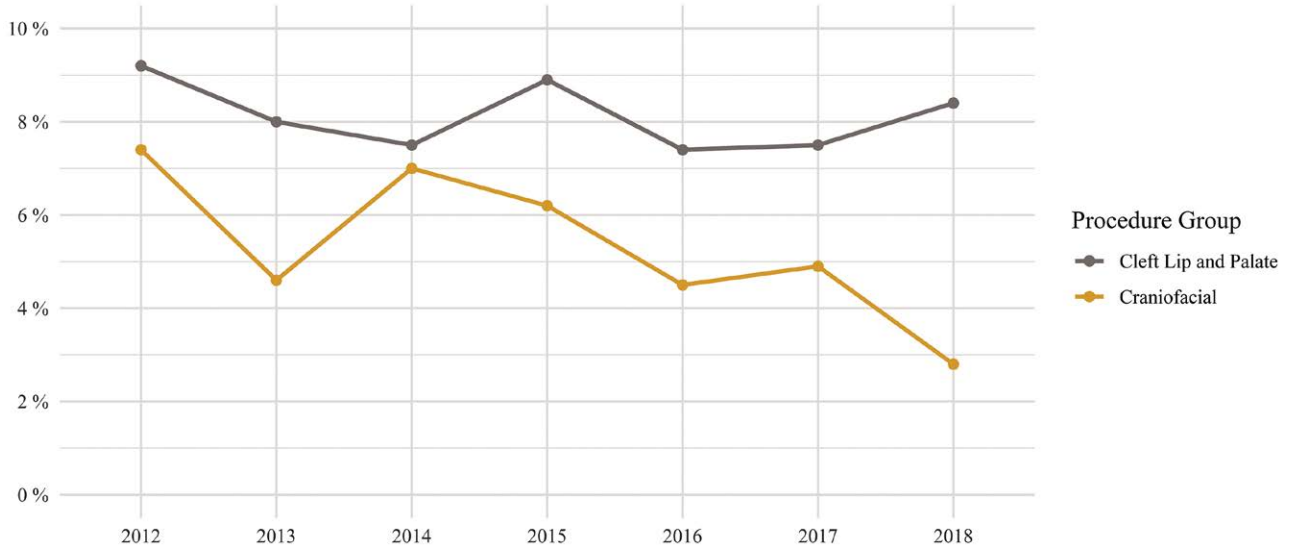

Fig. 2. Change in rate of extended lengths of stay for each procedure group.

of blood transfusion from 2012 to 2018 (59.52% versus 47.37%; $P < 0.001$). A significantly higher proportion of readmitted patients underwent reoperation than those who were not readmitted (47.6% versus 1.3%; $P < 0.001$). Reoperation and readmission status did not significantly vary by race during the study period ($P > 0.05$; Table 4).

Patients identifying as Hispanic had a significantly lower morbidity rate compared to the overall sample per year by a factor of 27% (IRR, 0.73; 95% CI, 0.64–0.82; $P < 0.001$; Fig. 6). Non-Hispanic patients had a significantly higher morbidity rate by a factor of 10% (IRR, 1.1; 95% CI, 1.04–1.16; $P < 0.001$; Fig. 6). This finding is likely due to the significantly higher incidence of blood transfusions among non-Hispanic patients relative to Hispanic patients (63% versus 41%; $P < 0.001$; Table 5). (**See figure, Supplemental Digital Content 5, http://links.lww.com/PRSGO/C395.**)

DISCUSSION

Our analysis of the NSQIP-P registry confirmed low surgical risk in both plastic procedural groups. Over the observation period of the study, there were statistically significant improvements in readmission rates in the CLP group and extended length of stay in the craniofacial group. These findings agree with prior retrospective reviews of pediatric plastic surgical procedures[7,10,11] and show promising reductions of adverse events in these procedure groups. Readmission rates in this study ranged from 1.7% to 4.7% comparable to those found

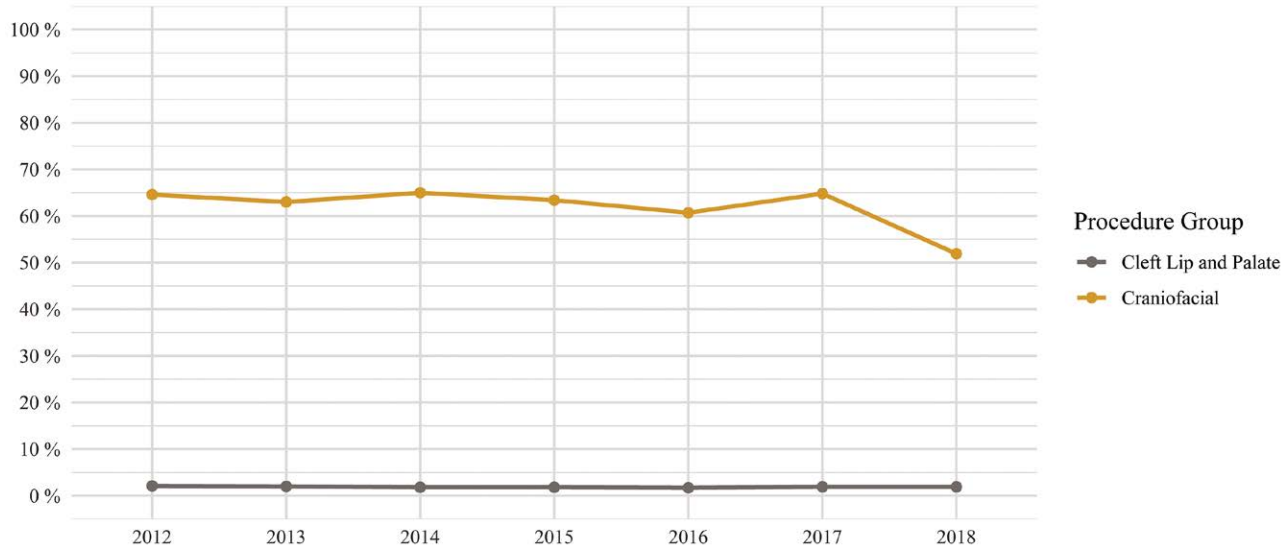

Fig. 3. Change in rate of 30-day morbidity for each procedure group.

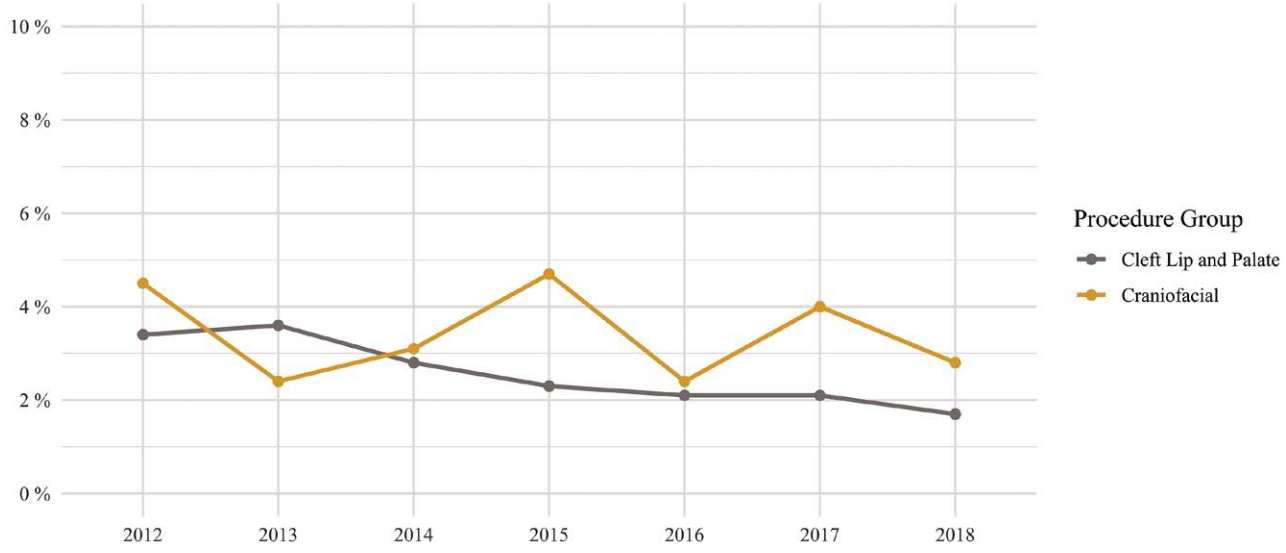

Fig. 4. Change in rate of readmissions for each procedure group.

Table 2. Cleft Lip and Palate Incidence Rates by Race

		Overall	Native*	Asian	Black or African American	White	Unknown/ Not Reported	
Outcome Measures	**Cases**	**25,072**	**295**	**2122**	**1898**	**16,981**	**3770**	***P***
Readmissions	n/N	615 (2.5%)	6 (2.0%)	46 (2.2%)	64 (3.4%)	390 (2.3%)	109 (2.9%)	**0.028**
	IRR	1	0.83	0.87	1.37	0.83	1.22	
	95% CI	—	(0.37–1.85)	(0.65–1.18)	(1.08–1.76)	(0.70–0.97)	(0.99–1.50)	
	P		0.64	0.38	**0.03**	**0.02**	0.06	
Extended length of stay	n/N	2,017 (8.0%)	17 (5.8%)	145 (6.8%)	188 (9.9%)	1,293 (7.6%)	374 (9.9%)	**<0.001**
	IRR	1	0.71	0.85	1.23	0.95	1.29	
	95% CI	—	(0.44–1.15)	(0.72–0.98)	(1.07–1.40)	(0.90–0.99)	(1.15–1.44)	
	P		0.16	**0.03**	**0.006**	**0.03**	**<0.001**	
Transfusion	n/N	24 (<0.1%)	0 (0%)	3 (0.1%)	4 (0.2%)	10 (<0.1%)	7 (0.2%)	
	IRR	1	0.00	1.55	2.44	0.34	2.33	
	95% CI	—	(0–0)	(0.46–5.18)	(0.83–7.14)	(0.15–0.77)	(0.96–5.61)	0.11
	P		0.59	0.48	0.09	**0.01**	0.05	

*Includes all American Indian, Alaskan Native, Native Hawaiian, and other Pacific Islander participants.
Values in boldface are statistically significant.

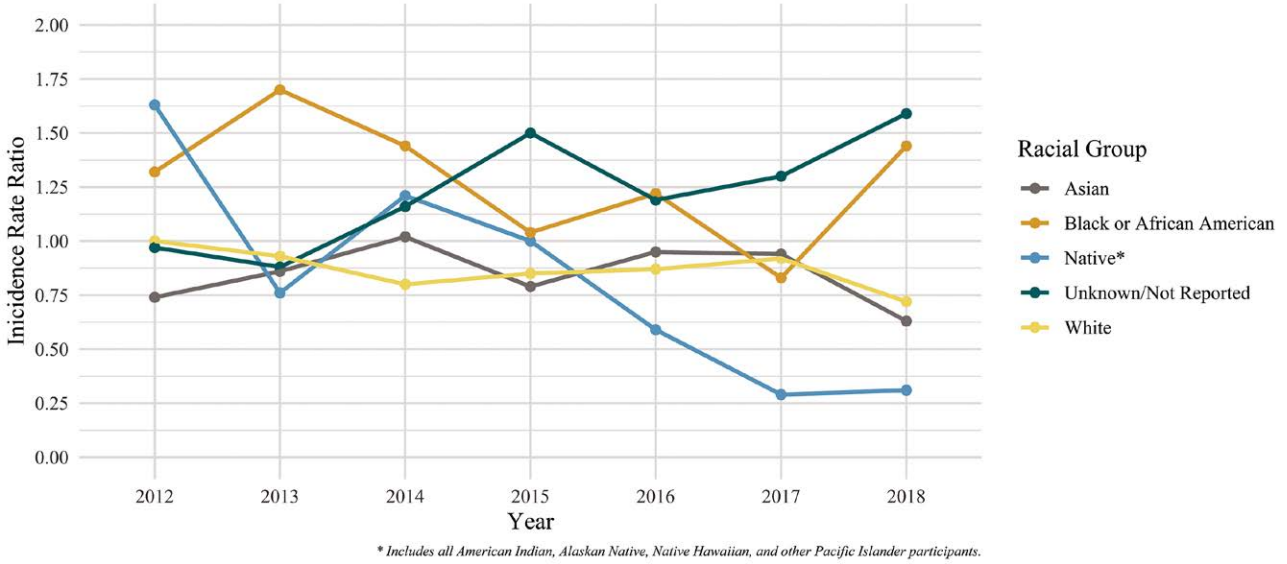

Fig. 5. Cleft lip and palate yearly incidence rates of extended lengths of stay for each racial group.

Table 3. Cleft Lip and Palate Incidence Rates by Ethnicity

Outcome Measures	Cases	Overall 25,072	Hispanic 3946	Non-Hispanic 18,895	Unknown/Not Reported 2231	*P*
Readmissions	n/N	615 (2.5%)	114 (2.9%)	446 (2.4%)	55 (2.5%)	0.15
	IRR	1	1.22	1.01	0.86	
	95% CI	—	(0.99–1.49)	(0.76–1.33)	(0.72–1.03)	
	P		0.06	0.97	0.10	
Extended length of stay	n/N	2017 (8.0%)	292 (7.4%)	1465 (7.8%)	260 (11.7%)	**<0.001**
	IRR	1	0.91	0.87	1.52	
	95% CI	—	(0.8–1.03)	(0.79–0.96)	(1.33–1.73)	
	P		0.12	**0.04**	**<0.001**	
Transfusion	n/N	24 (<0.1%)	2 (<0.1%)	18 (<0.1%)	4 (0.2%)	0.3
	IRR	1	0.49	0.98	2.05	
	95% CI	—	(0.11–2.07)	(0.39–2.47)	(0.70–5.99)	
	P		0.32	0.97	0.18	

Values in boldface are statistically significant.

Table 4. Craniofacial Incidence Rates by Race

Outcome Measures	Cases	Overall 3075	Native* 44	Asian 88	Black or African American 269	White 2153	Unknown/ Not Reported 521	*P*
Readmissions	n/N	105 (3.4%)	3 (6.8%)	4 (4.5%)	10 (3.7%)	69 (3.2%)	19 (3.6%)	0.7
	IRR	1	2.03	1.34	1.10	0.82	1.08	
	95% CI	—	(0.64–6.39)	(0.49–3.65)	(0.57–2.11)	(0.55–1.23)	(0.66–1.78)	
	P		0.22	0.56	0.78	0.34	0.75	
Extended length of stay	n/N	162 (5.3%)	2 (4.5%)	1 (1.1%)	23 (8.6%)	107 (5.0%)	29 (5.6%)	0.053
	IRR	1	0.86	0.21	1.73	0.83	1.07	
	95% CI	—	(0.21–3.47)	(0.03–1.51)	(1.11–2.68)	(0.6–1.15)	(0.72–1.6)	
	P		0.83	0.09	**0.01**	0.27	0.75	
Transfusion	n/N	1764 (57.4%)	23 (52.3%)	45 (51.1%)	153 (56.9%)	1296 (60.2%)	247 (47.4%)	**<0.001**
	IRR	1	0.91	0.89	0.99	1.19	0.80	
	95% CI	—	(0.6–1.37)	(0.66–1.19)	(0.84–1.17)	(1.07–1.32)	(0.7–0.91)	
	P		0.65	0.43	0.91	**<0.001**	**<0.001**	

*Includes all American Indian, Alaskan Native, Native Hawaiian, and other Pacific Islander participants.
Values in boldface are statistically significant.

by Kulaylat et al[7] of 1.3%. In that review, the authors assessed 130,274 pediatric patients for 2 years across multiple specialties and saw significant heterogeneity in readmission rates between specialties and patient populations.[7] As surgical readmissions are classified as unplanned and by their proximity to the index surgery, adhering to a 30-day duration of postoperative readmission ensured a causal association.

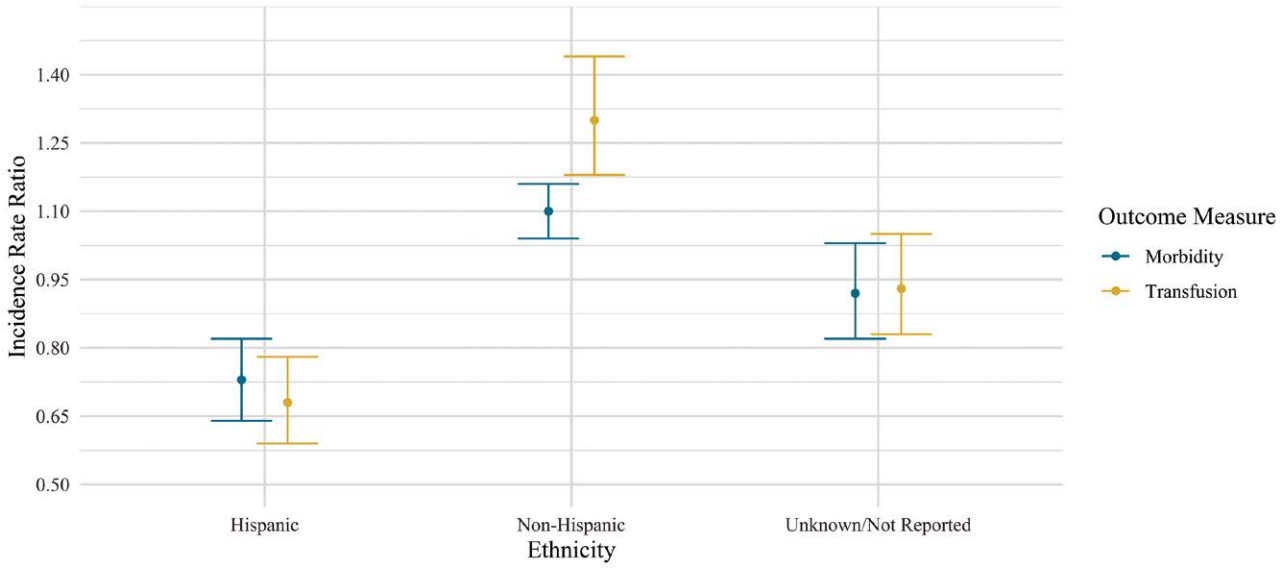

Fig. 6. Craniofacial morbidity and transfusion incidence rates by ethnicity.

Table 5. Craniofacial Incidence Rates by Ethnicity

		Overall	Hispanic	Non-Hispanic	Unknown/Not Reported	
Outcome Measures	**Cases**	**3,075**	**537**	**1905**	**633**	***P* Value**
Readmissions	n/N	105 (3.4%)	20 (3.7%)	70 (3.7%)	15 (2.4%)	0.3
	IRR	1	1.11	1.23	0.64	
	95% CI	—	(0.68–1.81)	(0.82–1.84)	(0.37–1.11)	
	P		0.67	0.32	0.11	
Extended length of stay	n/N	162 (5.3%)	24 (4.5%)	107 (5.6%)	31 (4.9%)	0.5
	IRR	1	0.82	1.19	0.91	
	95% CI	—	(0.53–1.27)	(0.86–1.65)	(0.62–1.35)	
	P		0.37	0.28	0.65	
Transfusion	n/N	1764 (57.4%)	222 (41.3%)	1198 (62.9%)	344 (54.3%)	**<0.001**
	IRR	1	0.68	1.30	0.93	
	95% CI	—	(0.59–0.78)	(1.18–1.44)	(0.83–1.05)	
	P		**<0.001**	**<0.001**	0.26	

Values in boldface are statistically significant.

Variations in readmission rates are specific to the index procedure. Compared to craniofacial patients, CLP patients were more likely to be readmitted for nonsurgical reasons. Reasons for readmission could include inadequate oral intake, respiratory difficulties, pain, or other issues. Additionally, surgical complications, such as wound dehiscence and wound infection, were rarely treated operatively within the 30-day timeframe, likely adhering to the standard practice in the treatment of wound dehiscence as reoperations are unlikely to yield better outcomes. Thus, wound dehiscence may warrant readmission but not reoperation. In 2018, readmission rates of superficial wound dehiscence cases were 19%, with only 6.2% of patients undergoing reoperation. It should be noted that while NSQIP-P does not discern the type of CLP case, prior evidence suggests that postoperative outcomes have significantly different results among cohorts. For example, in one study, the majority (75%) of wound complications in a Van der Woude cohort were classified as severe compared to 13% for nonsyndromic CLP.[12] While there was no statistically significant difference in the number of procedures, Van de Woude patients were at a higher risk of developing fistulae within the isolated cleft palate and bilateral cleft lip cohorts.[12] As the nature of the complication is unique to each case, identifying the underlying diagnosis of CLP cases within NSQIP-P could clarify the circumstances of reoperation.

While reoperation rates and 30-day morbidity steadily declined throughout the study, readmission rates remained relatively stable. For example, CLP patient rates of reoperation and readmission in 2018 diverged ($R = 0.22$, $P < 0.005$) with 30-day morbidity at its lowest for CLP, and craniofacial cases. The authors hypothesized that as fewer patients had undergone reoperations, and as 30-day morbidity had fallen, this would lead to decreased readmission, yet this was contrary to what was observed. One possible explanation is that the nature of 30-day morbidity and reoperation is coincident, with patients experiencing complications (outside the tracked morbidity measures) that would warrant readmission but not reoperation. If there are additional morbidity measures that are not being specifically tracked (leading to readmission but not

reoperation), they will likely be missed by quality improvement initiatives. While the decrease in rates of reoperation 30-day morbidity is a testament to quality improvement, the lack of significant improvement in readmission rates requires further investigation to uncover potential other areas of improvement.

Cranial vault remodeling is one of the most hemorrhagic interventions, with postoperative transfusion rates as high as 81.8%.[13] For the craniosynostosis cases in this study, transfusion rates decreased from 59.5% to 47.4% and were found to be the clear driver of decreasing 30-day morbidity. While our study did not discern total blood transfused, growing uncertainty surrounding evaluation of blood loss proportional to suture involvement and surgical techniques has put transfusion threshold rates at the forefront of craniosynostosis surgical management. A few interventions that have been shown to decrease intraoperative blood loss in these operations include cell salvage or the use of antifibrinolytic agents such as tranexamic acid.[13] It is reassuring that the widespread adaptation of these interventions has decreased transfusion rates in this nationwide sample, highlighting the importance of discerning long-term trends. It also underscores the importance of continued innovation and additional safety measures for future improvements.

Disparities in access to subspecialty care, such as pediatric plastic surgery, have been at the forefront of recent literature discussion. A 2016 study found the odds of being referred for care to a specialist significantly differed by race,[14] implying early health-seeking behaviors such as specialist referrals to be impaired by distance to primary care offices, insurance types, and household income. Together with other supporting data,[15,16] these results find socioeconomic factors contributing to the age variation in pediatric craniofacial care. Several NSQIP-P studies have found racial disparities in postoperative complication rates.[17–22] A study of patients under 2 years of age who had undergone primary CLP repair identified by NSQIP-P over 5 years (2013–2018) revealed that while cleft palate repair rates over time have decreased in Black, Hispanic, and Asian patients compared to White children, Black and Hispanic patients were at an 80% higher likelihood to be readmitted to the hospital following primary cleft lip repair.[23] Similarly, our results showed only one statistically significant finding in the CLP procedure group where Black or African American patients were two times more likely to undergo readmission and reoperation than White patients. While this is a significant difference, the authors could discern no other statistically significant racial or ethnic disparities. The aggregate data from this and previous studies suggest that quality improvement focus should be placed on studying and improving access to plastic surgical procedures for racial minorities while addressing racial disparities in surgical care, primarily in CLP procedures.

Quality improvement of surgical practices has become an increasing necessity in health care. Granular investigation into postoperative complications and causes of readmission and reoperation will benefit patient care and highlight areas for improvement. This study's incidence of reoperation and 30-day morbidity rates represent benchmark outcomes following pediatric plastic surgery. Following the clinical pathway of reoperation cohorts can further our understanding of patient risk. For example, previous studies have put pediatric patients with surgical site infections that occurred before the index procedure at higher risk of readmission, prolonged hospitalizations, and longer operative times.[11] While this type of data is not currently collected by NSQIP, additional granularity in data can improve risk stratification. Increasing institutional involvement of clinical registries such as NSQIP-P will better evaluate complex and heterogeneous populations.

This study had limited follow-up time to 30 days after surgery; long-term or existing complications were not captured and included in analyses. Furthermore, trends in unique ICD codes were not stratified and are rather reported in their group totality. This method of analysis was utilized to gain a generalized understanding of clinical trajectories following a class of procedures in pediatric populations. As such, the clustered schema of ICD codes within craniofacial and CLP procedures may lead to an overweighting of complications that may only be caused by a singular diagnosis, rather than an equal likelihood of postoperative complications across all ICD codes within a group. In addition, as NSQIP performs sampling of key procedures, this may not adequately represent the entire population. The granularity of the data is lacking, in that very few details about a recorded complication are available. While this issue does not allow a "deep dive," the large dataset is suitable for statistical analysis and discernment of broad themes such as trends. Finally, preoperative status and conditions of the patients are not fully available, thus making some comparisons prone to error.

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