Variation in Unplanned Admission Rates Post-Ambulatory Surgery

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Abstract

Aim: Study race & unplanned admission (UA) post-ambulatory surgery.
Methods: Retrospective analysis of ambulatory surgeries from July 2014-June 2023 served by single academic institution. Cases surveyed for age, race, gender, length of stay (LOS), ASA status, BMI, start time, muscle relaxant use, COVID-19 vaccination, surgical specialty, academic year.
Results: UA rates were higher for Black & Other patients compared to White patients, even after multiple covariate adjustment. Overall UA rates have risen since 2014, especially for Black patients, with consistently higher UA rates than White patients throughout study.
Conclusion: Minorities, especially Black patients, face higher UA rates post-ambulatory surgery.

Keywords: Ambulatory Surgery, Racial Disparity, Racial Health Disparity.

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Introduction

Changes in surgical care over the past few decades have shifted many surgeries from the inpatient to ambulatory setting.(1) While previously restricted to simple surgeries and healthy patients with low risks of morbidity and mortality, ambulatory surgery is now available to patients with more complex conditions and increasingly complicated procedures.(1) Given that ambulatory surgery is economical and efficient, and for many, convenient; it has increasingly become the preferred setting for many procedures.(2)

However, unplanned admissions after ambulatory surgery temper some of these advantages, such as those previously mentioned, including reduced risk of infection, less stressful overall experience compared to traditional hospital inpatient stay, and generally faster recovery in the comfort of their own home.(3) Recent literature(1–8) has suggested racial disparities in access to outpatient surgery and post-operative readmissions. However, few have explored the association of race with unplanned admission post-ambulatory surgery, and none have previously included all outpatient surgeries at an American institution for greater than 8 years.

Given these previous findings, we hypothesize that unplanned admissions disproportionately affect groups that have been historically marginalized, thus not receiving the full benefits of ambulatory surgery. We herein assess how race may influence the rate of unanticipated admission post-ambulatory surgery.

Methods

We performed a cross-sectional, retrospective analysis of all ambulatory surgeries served by the Department of Anesthesiology at the University of North Carolina (UNC) at Chapel Hill (single-center, tertiary care, academic institution in Southeast United States) from July 1, 2014 to June 30, 2023. This study was approved by UNC IRB committee (#16-0950) and requirement for written informed consent was waived. Ambulatory cases were identified based on surgery class labeled as "Outpatient" or "Hospital Outpatient."

Cases were surveyed for age, gender, race, length of stay (LOS), American Society of Anesthesiologists (ASA) Physical Status, body mass index (BMI), anesthesia start time (morning vs. afternoon), muscle relaxant use, COVID-19 (SARS-CoV-2) vaccination, surgical specialty, and academic year (labeled with beginning calendar year only) from the electronic medical record. These covariates were selected based on their association with operative risk and were used to help isolate the correlation between race and unplanned admission in our logistic regression model. It may be surprising that a patient classified at ASA 4 would have planned outpatient surgery. However, relatively simple procedures may be performed in the outpatient setting, such as AV fistula procedures in renal failure patients or minor skin surgeries in cardiac patients.

Five racial categories were included: American Indian/Alaskan Native (AIAN), Asian, Black, Other, Unknown, and White. These categories were chosen based on having a case load greater than 2,000 during our study period. Other is defined as having a different race indicated, "Other" race reported, or more than 1 race reported. Unknown is defined as "prefer not to answer" or blank. Unplanned admissions occurred on the same day as surgery and were defined as cases with a LOS of 1 day or more. LOS of 0 days was considered same-day discharge.

Since Epic was implemented at our institution in May 2014, we elected to use academic year (beginning of July to end of June) as we wanted to compare full 12-month periods without losing data from 2014. All personal record information was removed from the data prior to analysis. Database was obtained using North Carolina Translational and Clinical Sciences Institute (grant-funded, UNC School of Medicine-associated institute that aids researchers in Clinical Informatics and Electronic Health Record Data). Most of our data is objective, however, we acknowledge that the race reported within Epic is subject to provider input and may not always be self-reported. While we strongly advocate for self-reporting, this also reflects observed race. This manuscript adheres to the applicable STROBE guidelines.

Statistical Analysis

Rates of unplanned admissions within patient groups (defined based on race, age, and academic year of surgery) were compared using a chi-squared test. For covariates with more than two categories, post hoc analysis was used to compare prespecified pairs of groups, and multiple tests were corrected using Bonferroni correction (5 tests). A multivariate analysis of the entire data set was also performed, adjusting for multiple covariates associated with post-surgical outcomes (detailed in the results). Missing percentages are very low (<1%) for all variables used in this study except for BMI (7.7% missing). As a result, only complete cases were used in analyses. The threshold for statistical significance for all tests was set at $p \leq 0.05$.

All statistical analyses were performed using R (version 4.3.2). The reference group for all comparisons were patients whose reported race was White.

In order to view data longitudinally and remove the possible biases that arise from assessing data collected over a long period of time (i.e., since clinical practice and the race distribution may have changed between 2014-2023), rates of unplanned admission following ambulatory surgery were plotted for each academic year of the study period. An analysis of variance (ANOVA) test was employed to determine if rates were different over the years. Logistic regression was used to evaluate overall admission rate trends and analyze the interaction between race, unplanned admission, and academic year.

Results

Overall Study Group:

The overall rate of unplanned admissions was 4.1% (13,791/335,815). The study population was 65.2% White, 20.6% Black, 10.0% Other, 1.8% Unknown, 1.6% Asian, and 0.8% American Indian/Alaskan Native (AIAN). The overall association between race and rates of unplanned admissions was significant (Table 1). Post hoc analysis showed that the rates of unplanned admission were higher for patients whose reported race was AIAN (5.3%, p <0.001), Black (5.0%, p <0.001), and Other (4.2%, p = 0.003), and lower for Asian (3.0%, p = 0.009) and Unknown (2.9%, p = 0.001), compared to White (3.9%, reference) patients.

Table 1 Race and Unplanned Admission. Overall association between race and rates of unplanned admission was significant. Post-hoc analysis showed that the rates of unplanned admission were higher for patients whose reports race was American Indian/Alaskan Native (AIAN), Black, Other, and lower for Asian and Unknown, compared to White patients (reference population).

Race	Unplanned Admission Rate	Unplanned Admissions/ Total	Corrected p-value from post-hoc
AIAN	5.3%	149/2,821	<0.001
Asian	3.0%	159/5,251	0.011
Black	5.0 %	3,429/69,192	<0.001
Other	4.2%	1,733/41,619	0.003
Unknown	2.9%	173/5,933	0.001
White	3.9%	8,456/219,071	Reference

ASA Status Stratification:

When stratified by ASA status, our findings remained similar to those for the overall group. A statistically significant higher rate of unplanned admissions was found for Black patients compared to White patients in all ASA statuses except 4 (p range < 0.001) (Figure 1). Patients of other race also had a higher rate of unexpected admission than White patients, reaching statistical significance in ASA 2-3 (p range 0.002). AIAN patients showed a statistically significant higher rate of unplanned admission in ASA 2 only (p < 0.001). ASA 4 showed no statistically significant differences.

Age Stratification:

When stratified by age group (i.e., 0-10, 11-20), analyses show Black patients have a statistically significant higher rate of unplanned admission compared to White patients in every decade of life from 11 to 70 (p range 0.001) (Figure 2). Patients who reported other race have statistically significant higher rates of unplanned admission in age groups 11-20 and 41-50 (p range < 0.001). Asian patients were statistically less likely to be admitted in the 61-70 age group when compared to White patients (p = 0.002).
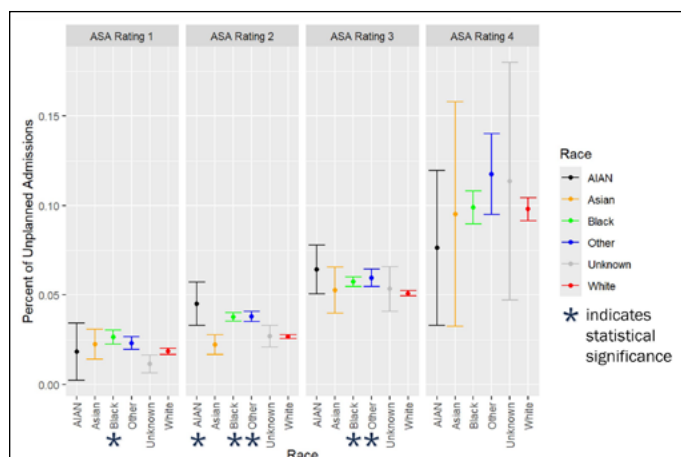

Figure 1. Association of Race with Unplanned Admission Post-Ambulatory Surgery Stratified by ASA Status. Stratification by ASA status shows that Black patients have a significantly higher rate of unplanned admissions compared to White patients in all ASA groups except 4. Patients of Other race also have higher rates in ASA 2-3, while AIAN patients show a higher rate only in ASA 2. No significant differences were found in ASA 4. * indicate statistical significance. AIAN = American Indian/Alaskan Native, ASA = American Society of Anesthesiologists (Physical Status).
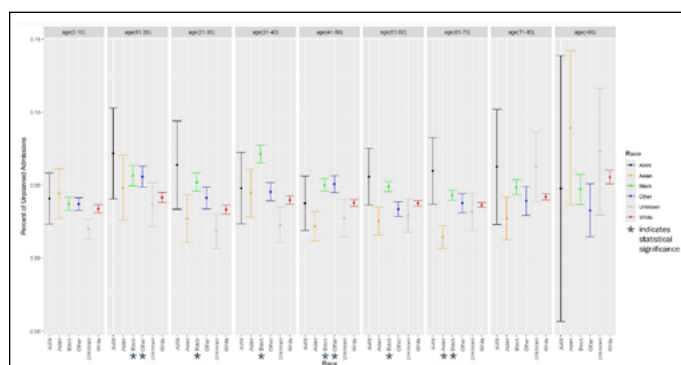

Figure 2. Association of Race with Unplanned Admission Post-Ambulatory Surgery Stratified by Age. Stratification by age group reveals that Black patients have a significantly higher rate of unplanned admissions compared to White patients across all age groups from 11 to 70. Patients of Other race have higher rates in age groups 11-20 and 41-50, while Asian patients are less likely to be admitted in the 61-70 age group compared to White patients. * indicate statistical significance. AIAN = American Indian/Alaskan Native, ASA = American Society of Anesthesiologists (Physical Status).

Multivariate Analysis:

A multivariate logistic regression model was run on the overall group examining the association of race with unplanned admission, adjusted for the following covariates: age, ASA status, gender, BMI group (Underweight <18.5, Healthy 18.5-24.9, Overweight 25-29.9, Obese 30-39.9, Severe Obesity 40), anesthesia start time (morning vs. afternoon), muscle relaxant use (yes vs. no), COVID-19 vaccination status, surgical specialty, and academic year (Table 2). Results suggest that compared with patients whose reported race was White, patients reported as Black (OR 1.1639, CI (1.114, 1.216), p < 0.0001) and Other (OR 1.1364, CI (1.066, 1.211), p < 0.0001) have a statistically significant higher rate of unplanned admission. Given the relatively high missing percentage for BMI (7.7%), multivariate analysis without BMI was conducted and produced very similar results to the model with BMI included, i.e., no change in significant results (Supplemental Table 1, shows unchanged significance compared to Table 2).

Table 2 Multivariate Logistic Regression of Race and Unplanned Admission. Adjusted with the following covariates: age, ASA status, gender, BMI group (Underweight <18.5, Healthy 18.5-24.9, Overweight 25-29.9, Obese 30-39.9, Severe Obesity ≥40), anesthesia start time (morning vs. afternoon), muscle relaxant use (yes vs. no), COVID-19 vaccination status, surgical specialty, and academic year. Results suggest that compared with patients whose reported race was White, patients reported as Black and Other have a statistically significant higher rate of unplanned admission. AIAN = American Indian/Alaskan Native, CI = Confidence Interval.

Race	Odds Ratio (95% CI)	P-value
AIAN	1.096 (0.913,1.305)	0.3162
Asian	0.984 (0.823,1.167)	0.8595
Black	1.164 (1.114, 1.216)	<0.0001
Other	1.136 (1.066, 1.211)	<0.0001
Unknown	1.081 (0.915, 1.268)	0.3519

Longitudinal Analysis:

Unplanned admission rates have risen for all patient populations since 2014 (Figure 3). Patients who were identified as Black consistently had higher rates of unplanned admission than patients who were identified as White, significant from 2015 academic year onwards (p range 0.003). Patients of Other race had significantly higher rates of unplanned admission from 2017-2019 academic years compared to White patients (p range 0.017). Additionally, relative to White patients, AIAN patients had a significantly higher admission rate in 2020 (p = 0.012) and Asian patients had a significantly lower rate in 2021 (p = 0.044).
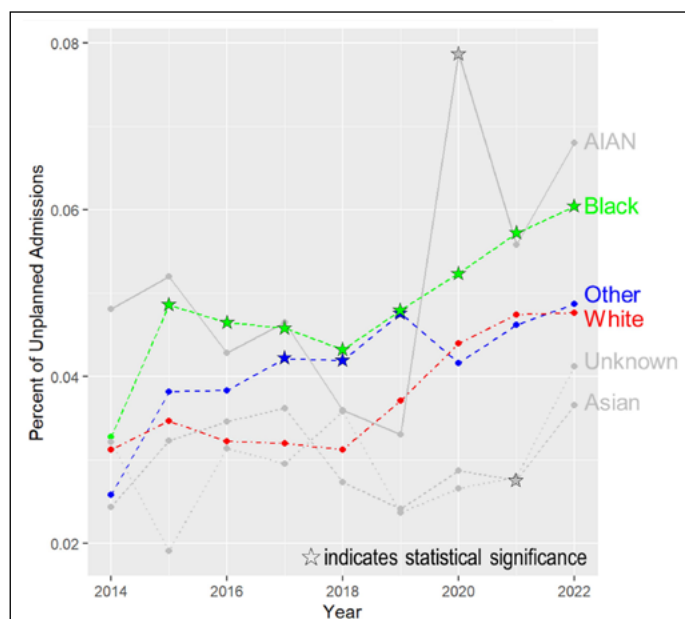

Figure 3. Unplanned Admission by Race and Academic Year. Data points that are statistically significant compared to White patients are starred. Unplanned admission rates have increased across all patient populations since 2014. Black patients have had higher unplanned admission rates than White patients since 2015 until the end of study period (p range ≤ 0.003). Compared to White patients, patients of Other race had higher admission rates from 2017-2019, AIAN patients had higher rates in 2020, and Asian patients had lower rates in 2021. AIAN = American Indian/Alaskan Native. Starred points indicate statistical significance.

ANOVA showed that unplanned admission rates were statistically different across the different academic years (p < 0.001). Under the assumption of linear change, results from logistic regression suggest that the overall odds of unplanned admission increased over time (OR 1.06, p < 0.0001). Again, under the assumption of linear change,

results from logistic regression analyzing race and year interaction suggest that (1) compared with White patients, the odds of unplanned admission are higher for Black patients (OR 1.36, p < 0.0001) and Other (OR 1.18, p = 0.0106) across the years; and (2) the odds of unplanned admission increases over time for White patients (OR 1.07, p < 0.0001).

Discussion

Racial disparities in ambulatory surgery have been extensively documented. Janeway et. al found that access to ambulatory care is lower for Black and Hispanic patients compared to White patients, even after adjusting for age, comorbidities, insurance, income, and procedure.(1) Studies looking at specific specialties or certain procedures have also reported similar findings. Within otolaryngology, Gadkaree et. al found that the odds of receiving care in an ambulatory setting was significantly lower for Black and patients of non-specified other races than White patients, despite controlling for comorbidities, income, and urban-rural status.(4)

When looking specifically at cholecystectomies, Janeway et. al concluded that the odds of undergoing ambulatory versus inpatient cholecystectomy were significantly lower in Black and Hispanic patients.(5) In another common outpatient procedure, total joint arthroplasty, it was found that Black patients were less likely to undergo this procedure compared to White patients, which held when adjusted for age, gender, race, BMI, ASA, functional status, smoking, and comorbidities.(6) Even within the pediatric population, patients of racial/ethnic minority background were less likely to receive ambulatory surgical intervention; adjusted odds of surgery in an ambulatory location were lower for all racial/ethnic minorities compared to White patients, even after controlling for income, insurance, and health status.(7)

Our findings echo these previous studies and may potentially provide some explanation for bias in access to ambulatory surgery. Despite accounting for multiple previously identified risk factors,(3,8) our study shows that for much of the ambulatory population, patients who were identified as Black had a consistently higher rate of unexpected admission post-ambulatory surgery compared to patients who were identified as White. Only in ASA 4, and age groups 0-10 and 70+ were there no statistically significant differences when stratified by ASA and decade of life, respectively. This is likely due to medical comorbidities primarily driving unplanned admissions when categorized in ASA 4 and/or 70+ years old or more widespread Medicare coverage. In 0-10 age group, patients may be protected by the relative health of youth, Medicaid coverage, or less time exposed to social drivers of health.

The inconsistent significance of patients of other race could be due to our definition, given it includes patients of mixed race and those who identify as Latine. Some hypotheses for these findings include systemic level factors (structural racism, required insurance preapproval), socioeconomic status factors (transport/escort, social support, income), and physician/patient preferences.(1,5,7)

Initially we suspected AIAN patients were only found to have a significant increased rate of unplanned admission in ASA 2 due to the spread of the population within each ASA status. However, Supplemental Figure 1 demonstrates the distribution of ASA status was not vastly different between AIAN and White population (40.8% of AIAN population was classified as ASA 2, 44.4% of White population was classified as ASA 2). We also considered this could be due to the relatively smaller population size of AIAN (2,821 AIAN vs 219,071 White patients), though it is still considered statistically significant. The exact reason remains unclear.

Notably, unplanned admission rates began to rise for everyone in 2020, which is likely attributable to the COVID-19 pandemic (Supplemental Figure 2, illustrates increase in outpatient surgeries during study period but especially after 2020). Many patients delayed elective surgeries to avoid hospitalization and COVID-19 exposure. Likewise, any surgeries that could be pushed to the outpatient setting were done to create space, in addition to avoiding hospital exposure. The combined effect would mean more complex surgeries and sicker, more urgent patients in the ambulatory setting. Prior to the pandemic, unplanned admission rates were never above 4.0% (Supplemental Figure 3, visualizes overall rise of unplanned admission rate by academic year). However, 2020 onwards, unplanned admission rates were above 4.0% until the end of the study period.

Notably, in 2020, AIAN patients had a significantly higher unplanned admission rate compared to White patients, suggesting the COVID-19 pandemic may have disproportionately impacted the AIAN community. It is known that the pandemic was a major driver in the trend towards outpatient surgery. This may have pushed patients and providers to pursue outpatient surgery in cases that were suboptimal for the ambulatory setting. The pandemic likely also exacerbated existing reasons for unplanned admission, such as comorbidities, socioeconomic disadvantage, and reduced access to treatment(9), with effects echoing throughout the end of the study period.

Reasons for unplanned admission after ambulatory surgery are likely multifactorial, including social, organizational, anesthetic, and medical causes.(3) Previous literature has identified reasons for unplanned admission post-ambulatory surgery as mainly social/ organizational (e.g., surgery ending after 3pm, unscheduled procedure, lack of escort or home support) and surgical (e.g., surgery length and type, unanticipated surgical complexity, post operative pain, fever, and/or bleeding).(2,3,8) The remaining unplanned admissions are accounted for by anesthetic (e.g., dizziness, post operative nausea and vomiting, inadequate level of consciousness, and urinary retention) and medical reasons (e.g., age, co-morbidities, and moderate to major illness severity).(3,8)

Unfortunately, sociodemographic barriers such as limited support networks at home immediately following surgery and lack of support following discharge are major contributors to unplanned admission,(4,5) and these challenges may disproportionately affect different population groups. Additionally, lack of paid time off work may push patients to pursue outpatient procedures versus a costly and timely hospital stay.(4,5) This emphasizes how thorough pre-operative screening and counseling may help avoid unplanned admissions. Differences in access to culturally competent care, variations in reimbursement, and physician bias may also play a role.

Given the study's retrospective design, we are unable to establish causality. Additionally, this is a single-center study from an academic, public institution in North Carolina. While the data are robust, the results may not generalize to other geographic regions or community-based settings with different case mixes or discharge practices. For reference, the University of North Carolina is a suburban tertiary care center that draws patients from all regions, from urban to rural areas, and has a wide range of socioeconomic levels within their patient population.

This study is also subject to documentation error and bias in observed versus patient-reported race. Although we encourage patient self-reporting of race/ethnicity, reporting is often left to the discretion of data source and thus may include observed race. Other possible confounding factors were not included in the database, such as ethnicity, reasons for admission, income, insurance status, socioeconomic status (via zip code-based proxies), comorbidity burden (Charleson Comorbidity Index), readmissions, and

emergency department visits. Unfortunately, these data points were not included in our original data set and were unable to be accessed at the time of this project. Additionally, other unmeasured factors such as medical/surgical complexity, intraoperative complications/ events, language preferences, and quality of provider interactions may influence findings. Lastly, there is unclear clinical significance as differences in unplanned admission rates are not large but do exist.

Ambulatory surgery is growing due to its cost-benefit and efficiency. However, groups that have been historically marginalized, particularly patients who are identified as Black, face disadvantages, even after adjusting for common predictors of unplanned admission. We acknowledge that without knowing whether these unplanned admissions were due to social, surgical, medical or anesthetic causes, the mechanisms driving disparities remain unclear. Thus, it is inappropriate to offer interventions aside from raising awareness of these disparities and conducting further investigations.

Nonetheless, identifying these worsening disparities will likely help inform future clinical practice and pre-operative planning. General recommendations at this time include encouraging more placements of patients on Enhanced Recovery After Surgery (ERAS) protocol(10), or other standardized protocols that help minimize unconscious and implicit bias in treatment. Future studies will include more variables, such as ethnicity, and focus on identifying the causes for unplanned admissions after ambulatory surgery to more effectively target preemptive interventions.

References

1. Janeway MG, Sanchez SE, Chen Q, Nofal MR, Wang N, Rosen A, et al. Association of Race, Health Insurance Status, and Household Income with Location and Outcomes of Ambulatory Surgery among Adult Patients in 2 US States. *Journal of the American Medical Association:Surgery* 2020;**155(12)**:1123–31.

2. Bongiovanni T, Parzynski C, Ranasinghe I, Steinman MA, Ross JS. Unplanned hospital visits after ambulatory surgical care. *PLoS One* 2021;16:1–13. Available from: http://dx.doi.org/10.1371/journal.pone.0254039

3. Van Caelenberg E, De Regge M, Eeckloo K, Coppens M. Analysis of failed discharge after ambulatory surgery: unanticipated admission. *Acta Chirurgica Belgica* 2019;119(3):139–45. Available from: https://doi.org/10.1080/00015458.2018.1477488

4. Gadkaree SK, McCarty JC, Sajjadi A, Dresner HS, Lindsay RW, Varvares MA, et al. Disparities in Index of Care for Otolaryngologic Procedures Performed in Ambulatory and Inpatient Settings. *Otolaryngology – Head and Neck Surgery* 2022;**167(5)**:821–31.

5. Janeway MG, Sanchez SE, Rosen AK, Patts G, Allee LC, Lasser KE, et al. Disparities in Utilization of Ambulatory Cholecystectomy: Results From Three States. *Journal of Surgical Research* 2021;**266**:373–82.

6. Amen TB, Varady NH, Wright-Chisem J, Bovonratwet P, Parks ML, Ast MP. Emerging Racial Disparities in Outpatient Utilization of Total Joint Arthroplasty. *Journal of Arthroplasty* 2022;**37(11)**:2116–21.

7. Groenewald CB, Lee HH, Jimenez N, Ehie O, Rabbitts JA. Racial and ethnic differences in pediatric surgery utilization in the United States: A nationally representative cross-sectional analysis. *Journal of Pediatric Surgery* 2022;**57(8)**:1584–91.

8. Cabaton J, Thy M, Sciard D, De Paulis D, Beaussier M. Unplanned admission after ambulatory anaesthesia in France: analysis of a database of 36,584 patients. *Anaesthesia Critical Care & Pain Medicine* 2021;**40(1)**:100794. Available from: https://doi.org/10.1016/j.accpm.2020.100794

9. Slutske WS, Conner KL, Kirsch JA, Smith SS, Piasecki TM, Johnson AL, et al. Explaining COVID-19 related mortality disparities in American Indians and Alaska Natives. *Scientific Reports* 2023;**13(1)**:20974.

10. Sauro KM, Smith C, Ibadin S, Thomas A, Ganshorn H, Bakunda L, et al. Enhanced Recovery after Surgery Guidelines and Hospital Length of Stay, Readmission, Complications, and Mortality: A Meta-Analysis of Randomized Clinical Trials. *Journal of the American Medical Association Network Open* 2024;**7(6)**:E2417310.

Supplemental Content

Supplemental Table 1 Multivariate Logistic Regression of Race and Unplanned Admission with BMI dropped. Adjusted with the following covariates: age, ASA status, gender, anesthesia start time (morning vs. afternoon), muscle relaxant use (yes vs. no), COVID-19 vaccination status, surgical specialty, and academic year. Results suggest that compared with patients whose reported race was White, patients reported as Black and Other have a statistically significant higher rate of unplanned admission. Unchanged significance from Table 2. AIAN = American Indian/Alaskan Native, CI = Confidence Interval.

| Race	Odds Ratio (95% CI)	P-value
AIAN	1.076 (0.901, 1.274)	0.4099146
Asian	1.035 (0.874, 1.215)	0.6862225
Black	1.167 (1.118, 1.218)	0.0000000
Other	1.114 (1.048, 1.184)	0.0005283
Unknown	1.031 (0.877, 1.204)	0.7097575
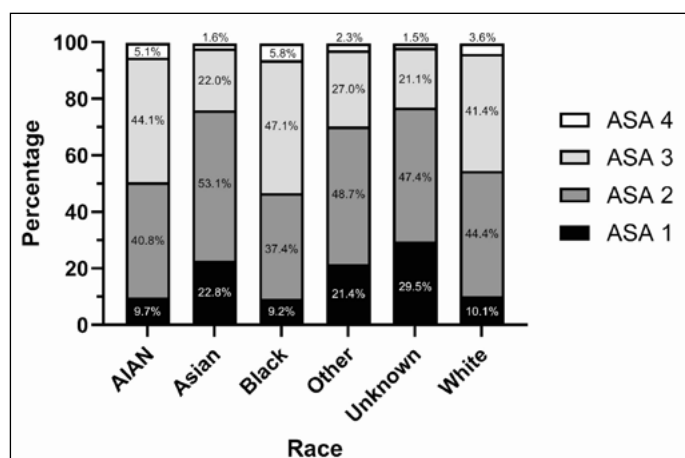
Supplemental Figure 1 Distribution of ASA Status by Race. The distribution of ASA status was not vastly different between AIAN and White population. Black patient population had a slightly higher proportion of patients classified as ASA 3 and 4 compared to White patients. Asian, Other, and Unknown had a higher percentage of patients classified as ASA 1 or 2 compared to White patients. AIAN = American Indian/Alaskan Native, ASA = American Society of Anesthesiologists (Physical Status).
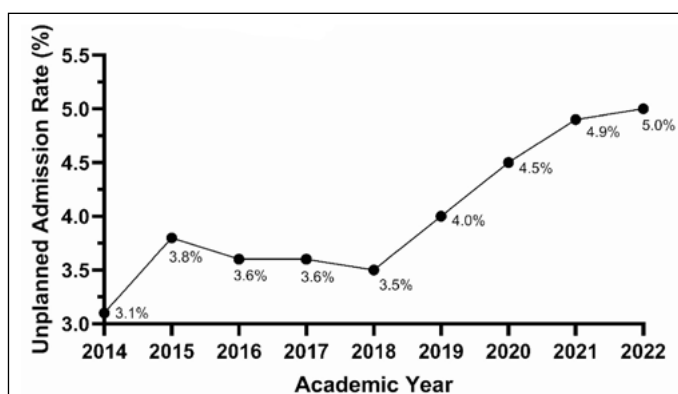
Supplemental Figure 3 Overall Rise of Unplanned Admissions Rate by Academic Year. Academic year (labeled with beginning calendar year, beginning of July to end of June) was used. Notably, prior to COVID-19 (SARS-CoV-2) pandemic, unplanned admission rates were never above 4.0%. However, 2020 onwards, unplanned admission rates were above 4.0% until the end of the study period.
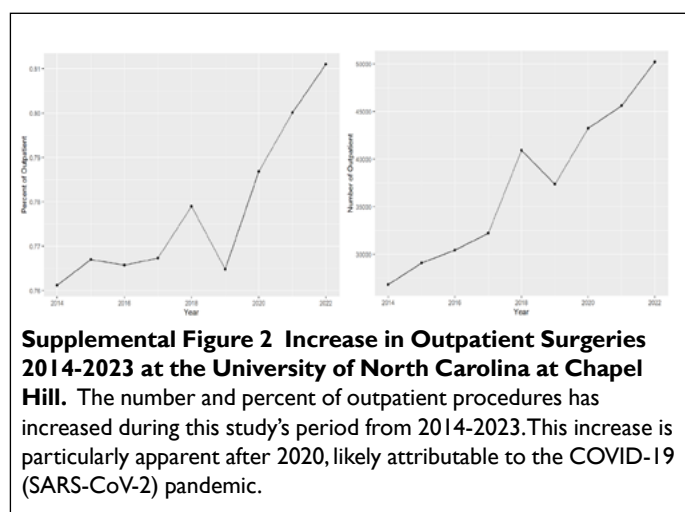
Supplemental Figure 2 Increase in Outpatient Surgeries 2014-2023 at the University of North Carolina at Chapel Hill. The number and percent of outpatient procedures has increased during this study's period from 2014-2023. This increase is particularly apparent after 2020, likely attributable to the COVID-19 (SARS-CoV-2) pandemic.