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ORIGINAL RESEARCH

Predictive Utility of Epic's Health Composite Score for Same-Day Cancellation in Cataract Surgery

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Purpose: To evaluate the predictive utility of the Epic Health Composite Score (HCS), an automated electronic health record (EHR)-derived risk stratification tool, for perioperative outcomes in cataract surgery.

Patients and Methods: This retrospective cohort study included 1204 adult patients who underwent elective phacoemulsification with intraocular lens implantation at the UNC Hillsborough Hospital Campus between January 2024 and January 2025. Epic HCS was analyzed as a continuous variable (per 5-point increase) and categorically (low risk: 0–8, medium risk: 9–20, high risk: ≥21). Perioperative outcomes assessed included same-day cancellation, operative duration, and anesthesia type selection. Other outcomes included surgical complications, prolonged inflammation, and visual acuity at postoperative month 1. Multivariable regression models adjusted for cataract complexity, ocular comorbidities, prior ocular surgery, and surgeon training level.

Results: The cohort included 268 (22.3%) low-risk, 641 (53.2%) medium-risk, and 295 (24.5%) high-risk patients. Same-day cancellation occurred in 53 cases (4.4%) and was 3.0%, 3.9%, and 6.8% for low-, medium-, and high-risk HCS categories, respectively (p = 0.060). Each 5-point increase in Epic HCS was independently associated with 23% higher odds of same-day cancellation (adjusted OR 1.23; 95% CI, 1.10–1.38; p<0.001). The model demonstrated moderate discriminative ability (AUC = 0.632). Epic HCS showed no association with operative duration, anesthesia selection, surgical complications, prolonged postoperative inflammation, or visual outcomes, which were instead predicted by ophthalmic-specific factors including cataract complexity, prior ocular surgery, and retinal or optic nerve pathology, as well as surgeon training level.

Conclusion: The Epic HCS independently predicts same-day surgical cancellation in cataract surgery patients but does not predict surgical outcomes. These findings support the utility of automated EHR-based risk scores for preoperative triage and care coordination to reduce cancellations, while underscoring that cataract surgery outcomes remain primarily determined by ophthalmic rather than systemic factors.

Keywords: risk stratification, electronic health records, surgical cancellation, preoperative assessment, ambulatory surgery, phacoemulsification

Introduction

Perioperative risk stratification has traditionally relied on validated instruments such as the American Society of Anesthesiologists (ASA) classification and procedure-specific metrics.[1] Recently, electronic health record (EHR)-derived models leveraging diagnoses, medications, laboratory values, and vital signs have been developed to automate risk assessment and guide resource allocation.[2–4] These include the Comorbidity Assessment for Surgical Triage (CAST) score for perioperative triage, the Rothman Index for inpatient acuity monitoring, and the Epic Deterioration Index for detecting acute clinical decompensation, among others- none of which have been evaluated in ambulatory ophthalmic surgery.[5,6] The Health Composite Score (HCS) generated by Epic (Epic Systems Corporation, Verona, Wisconsin, USA)

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represents one such tool, synthesizing weighted healthcare utilization, clinical, and demographic variables into a score ranging from 0–100.[7]

Cataract surgery provides a particularly relevant setting for evaluating perioperative risk assessment tools. As the most commonly performed surgical procedure worldwide, with approximately 4 million cases annually in the United States, cataract surgery generally achieves excellent outcomes but presents several perioperative challenges.[8] Same-day cancellations occur in approximately 5% of ambulatory ophthalmic surgery cases, commonly arising from inadequate preoperative medical optimization, anesthesia-related concerns, or acute medical decompensation.[9] Many patients undergoing cataract surgery have significant systemic comorbidities, such as diabetes mellitus and hypertension, that are routinely considered during anesthesia assessment.[10,11] For example, patients with advanced cardiopulmonary disease may have a limited tolerance of supine positioning necessitating general anesthesia (GA) over monitored anesthesia care (MAC), which provides conscious sedation with preserved spontaneous breathing.[12,13] Additionally, intraoperative and postoperative complications following cataract surgery still occur in 3–5% of cases.[14,15] Because systemic health complexity may impact both perioperative management and surgical outcomes, tools that facilitate earlier identification of at-risk patients could enable interventions to improve surgical readiness and patient counseling.[16,17]

Despite advances in EHR-based risk stratification, there is limited evidence examining whether automated scores predict perioperative outcomes in ambulatory cataract surgery. This procedure is characterized by features- predominantly outpatient delivery, high volume, and generally lower risk- that distinguish it from the inpatient and major surgery populations for which such scores have been validated. Furthermore, few if any existing tools have been evaluated for predicting same-day surgical cancellations, a key driver of inefficiency in surgical settings. Prior attempts to leverage EHR data for cancellation prediction have relied on custom-built machine learning models requiring development and validation, such as those applied in pediatric and urologic surgeries.[18,19] By contextualizing the performance of a pre-existing, automatically generated EHR-derived HCS alongside established clinical and procedural complexity, this study aims to evaluate its predictive utility for perioperative planning for cataract surgery.

Materials and Methods

This retrospective cohort study was approved by the University of North Carolina (UNC) Institutional Review Board (IRB 25–1155), conducted in accordance with the Declaration of Helsinki, and reported following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. The requirement for informed consent was waived due to the retrospective design and minimal risk to subjects. All patient identifiers were removed prior to analysis.

Adult patients aged ≥18 years who underwent elective phacoemulsification with intraocular lens implantation at UNC Hillsborough Hospital Campus between January 2024 and January 2025 were identified via the institutional i2b2 data warehouse and Epic EHR. Exclusion criteria included emergent/trauma-related cases, absent Epic HCS, and incomplete preoperative, intraoperative, or postoperative records.

The Epic HCS integrates multiple weighted components including inpatient hospitalizations and emergency department visits in the prior year, chronic conditions, active outpatient medications, and the number of unique licensed providers seen within the same period as a measure of care fragmentation. Additional variables include patient age, the presence or absence of a designated primary care provider, and insurance status, as described in an institutional training document.[7] Specific point assignments for each component are proprietary to Epic Systems and not publicly available. The Epic HCS was extracted at the time of data collection (May 2025) and reflects clinical data accrued through the study period. The score was analyzed both as a continuous variable (per 5-point increase) and categorically using Epic's established risk strata: low risk (HCS 0–8), medium risk (HCS 9–20), and high risk (HCS ≥21).

Clinical and demographic information were manually abstracted into secure spreadsheets. Variables collected included age, sex, race/ethnicity, body mass index (BMI), systemic comorbidities (diabetes, hypertension), surgeon training level (attending/fellow/resident), surgical complexity (routine/complex), Epic HCS, ocular surface disease, retinal/optic nerve pathology, prior ocular surgery, and baseline best corrected visual acuity (BCVA). Retinal/optic nerve pathology was defined as the presence of glaucoma, age-related macular degeneration, diabetic retinopathy, retinal vein occlusion, epiretinal membrane, or optic neuropathy. Ocular surface disease included dry eye disease, blepharitis, or corneal pathology such as Fuchs' endothelial dystrophy. Complex cataract classification was determined by billing codes, with reasons including small pupil, phacodonesis, traumatic cataract, zonular dehiscence, or dense brunescent lens.

Perioperative outcomes assessed included same-day cancellation, operative duration, and anesthesia type selection (MAC vs GA). Surgical complications included intraoperative complications (posterior capsule rupture, retained lens fragment) and postoperative complications (iritis, cystoid macular edema). Additional postoperative outcomes included prolonged inflammation (defined as corneal edema or anterior chamber cell/flare on slit-lamp examination at either postoperative month [POM] 1 or POM 3) and BCVA at POM 1, converted to logarithm of the minimum angle of resolution (logMAR) units.

Continuous variables were expressed as means ± standard deviation or medians with interquartile ranges, and categorical variables as frequencies and percentages. Bivariate comparisons across HCS strata were performed using Kruskal–Wallis tests for continuous variables and chi-square or Fisher's exact tests for categorical variables, as appropriate. Multivariable logistic regression assessed the association between Epic HCS and binary outcomes (same-day cancellation, complications, inflammation), reporting adjusted odds ratios (aORs) and 95% confidence intervals (CI). Linear regression evaluated continuous outcomes (operative duration, postoperative BCVA), reporting regression coefficients (β) and 95% CIs. The Epic HCS was analyzed per 5-point increase to improve interpretability given the risk strata span ranges of 8–12 points.

Covariate adjustment was tailored to each outcome based on clinical relevance and event rates. For same-day cancellation and anesthesia selection, models adjusted only for cataract complexity, as ocular comorbidities and surgeon training level are not established determinants of these perioperative decisions. For surgical complications, prolonged inflammation, operative duration, and visual acuity, models additionally adjusted for ocular surface disease, retinal/optic nerve pathology, prior ocular surgery, and surgeon training level, due to their known influence on surgical difficulty and postoperative outcomes. Model discrimination for binary outcomes was evaluated using the area under the receiver operating characteristic curve (AUC). Two-tailed p-values less than 0.05 were considered statistically significant. Post-hoc power analysis indicated 80% power to detect adjusted odds ratios per 5-point HCS increase of 1.24 for same-day cancellation, 1.17 for surgical complications, and 1.13 for prolonged inflammation at $\alpha = 0.05$, with greater than 95% power for continuous outcomes.[20] All statistical analyses were performed in R (version 4.5.1; R Foundation for Statistical Computing, Vienna, Austria).

Results

Among 1204 included patients, the Epic HCS categorized 268 (22.3%) as low-risk (HCS 0–8), 641 (53.2%) as medium-risk (HCS 9–20), and 295 (24.5%) as high-risk (HCS ≥21). Patients in higher HCS categories were older and had a higher prevalence of obesity (both $p < 0.05$). Racial and ethnic distribution differed significantly across HCS groups ($p = 0.007$), with a greater proportion of Black patients in the high-risk category. As expected, systemic comorbidity burden increased markedly across HCS groups, including higher rates of diabetes and hypertension (both $p<0.001$). In contrast, ophthalmic factors- including retinal or optic nerve pathology, ocular surface disease, prior ocular surgery, cataract complexity, and preoperative visual acuity- did not differ significantly across HCS groups. Surgeon training levels also varied across HCS categories ($p = 0.005$), with increased trainee involvement among patients with higher Epic HCS. Baseline demographic and clinical characteristics are summarized in Table 1.

Perioperative Outcomes

Same-day surgical cancellation occurred in 53 of scheduled cases (4.4%) (Table 2). When stratified by Epic's risk categories, cancellation rates increased across groups: low risk (3.0%), medium risk (3.9%), and high risk (6.8%). Patients in the high-risk group demonstrated 2.3-fold higher cancellation rates compared to low-risk patients, although differences across groups did not reach statistical significance in unadjusted analysis ($p = 0.06$). In multivariable logistic regression adjusting for cataract complexity, each 5-point increase in Epic HCS was independently associated with 23% higher odds of same-day cancellation (aOR = 1.23; 95% CI, 1.10–1.38; $p<0.001$; AUC = 0.632) (Table 3). Model discrimination was assessed using the AUC (0.632), and calibration was evaluated using the Hosmer-Lemeshow

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Table 1 Baseline Characteristics by Epic Health Composite Score Risk Category

Characteristic	Low Risk (0–8) (N = 268)	Medium Risk (9–20) (N = 641)	High Risk (≥21) (N = 295)	Overall (N = 1204)	p-value
Age (years)	67.2 (11.6)	70.1 (10.2)	70.8 (10.1)	69.6 (10.6)	**<0.001**
Sex					0.3
F	149 (56%)	383 (60%)	161 (55%)	693 (58%)	
M	119 (44%)	258 (40%)	134 (45%)	511 (42%)	
Race/Ethnicity					**0.007**
White	155 (58%)	390 (61%)	166 (56%)	711 (59%)	
Black	45 (17%)	124 (19%)	82 (28%)	251 (21%)	
Asian	13 (4.9%)	24 (3.7%)	5 (1.7%)	42 (3.5%)	
Hispanic	41 (15%)	79 (12%)	37 (13%)	157 (13%)	
Other	14 (5.2%)	24 (3.7%)	5 (1.7%)	43 (3.6%)	
BMI Category[a]					**0.024**
Underweight (<18.5)	7 (2.7%)	15 (2.4%)	9 (3.1%)	31 (2.6%)	
Normal (18.5–24.9)	92 (35%)	188 (29%)	72 (24%)	352 (30%)	
Overweight (25–29.9)	78 (30%)	231 (36%)	92 (31%)	401 (34%)	
Obese (≥30)	83 (32%)	204 (32%)	122 (41%)	409 (34%)	
Diabetes	55 (21%)	227 (36%)	175 (60%)	457 (38%)	**<0.001**
Hypertension	134 (50%)	443 (69%)	250 (85%)	827 (69%)	**<0.001**
Epic HCS	5.5 (2.1)	13.9 (3.3)	28.7 (8.3)	15.7 (9.5)	**<0.001**
Retinal/Optic Nerve Pathology	88 (33%)	234 (37%)	106 (36%)	428 (36%)	0.6
Ocular Surface Disease	74 (28%)	188 (30%)	99 (34%)	361 (30%)	0.3
Prior Ocular Surgery	41 (15%)	80 (13%)	27 (9.2%)	148 (12%)	0.08
Cataract Complexity					0.068
Routine	219 (82%)	527 (82%)	224 (76%)	970 (81%)	
Complex	49 (18%)	114 (18%)	71 (24%)	234 (19%)	
Surgeon Training Level					**0.005**
Attending	161 (60%)	380 (59%)	154 (52%)	695 (58%)	
Fellow	101 (38%)	239 (37%)	118 (40%)	458 (38%)	
Resident	6 (2.2%)	22 (3.4%)	23 (7.8%)	51 (4.2%)	
Anesthesia Type					0.13
MAC	261 (97%)	633 (99%)	284 (97%)	1178 (98%)	
GA	7 (2.6%)	9 (1.4%)	10 (3.4%)	26 (2.2%)	
Preoperative BCVA[b] (logMAR)	0.33 (0.18–0.60)	0.30 (0.18–0.60)	0.34 (0.18–0.54)	0.34 (0.18–0.60)	0.83

Notes: Data presented as mean (SD) for continuous variables and n (%) for categorical variables. Bold values indicate statistical significance (p<0.05). [a] BMI data were missing for 11 patients (0.9%). [b] Preoperative BCVA is reported as median (IQR).
Abbreviations: BMI, body mass index; HCS, health composite score; MAC, monitored anesthesia care; GA, general anesthesia; BCVA, best correct visual acuity.

Table 2 Perioperative Outcomes by Epic Health Composite Score Risk Category

Outcome	Low Risk (0–8) (N = 268)	Medium Risk (9–20) (N = 641)	High Risk (≥21) (N = 295)	Overall (N = 1204)	p-value
Same-day cancellation	8 (3.0%)	25 (3.9%)	20 (6.8%)	53 (4.4%)	0.060
Operative time (min)	16.5 (8.4)	16.7 (7.3)	17.3 (7.3)	16.8 (7.6)	0.063
Surgical complications	19 (7.1%)	54 (8.4%)	27 (9.2%)	100 (8.3%)	0.7
Prolonged postoperative inflammation	37 (13.8%)	126 (19.7%)	56 (19%)	219 (18.2%)	0.2
Postoperative BCVA[a] (logMAR)	0.14 (0.04–0.22)	0.14 (0.04–0.30)	0.14 (0.04–0.26)	0.14 (0.04–0.26)	0.8

Notes: Data presented as mean (SD) for continuous variables and n (%) for categorical variables. [a] Postoperative BCVA is reported as median (IQR).
Abbreviations: BCVA, best corrected visual acuity; logMAR, Logarithm of the Minimum Angle of Resolution.

Table 3 Multivariable Regression Models for Perioperative Outcomes

Group	Variable	Estimate[a]	95% CI	p-value
Same-Day Cancellation	Epic HCS	1.23	1.10, 1.38	**<0.001**
	Complex Cataract	1.40	0.72, 2.58	0.3
Anesthesia Type (General vs MAC)	Epic HCS	1.04	0.85, 1.24	0.7
	Complex Cataract	2.21	0.93, 4.93	0.059
Surgical Complications	Epic HCS	1.09	0.99, 1.21	0.080
	Retinal/Optic Nerve Pathology	0.89	0.56, 1.39	0.6
	Ocular Surface Disease	0.91	0.56, 1.43	0.7
	Prior Ocular Surgery	2.20	1.23, 3.80	**0.006**
	Complex Cataract	3.25	2.08, 5.03	**<0.001**
	Surgeon Training Level			
	Attending	—	—	
	Fellow	1.96	1.26, 3.06	**0.003**
	Resident	1.02	0.28, 2.81	>0.9
Prolonged Postoperative Inflammation	Epic HCS	1.03	0.95, 1.11	0.5
	Retinal/Optic Nerve Pathology	1.50	1.10, 2.05	**0.010**
	Ocular Surface Disease	1.07	0.77, 1.47	0.7
	Prior Ocular Surgery	1.34	0.86, 2.04	0.2
	Complex Cataract	1.71	1.19, 2.43	**0.004**
	Surgeon Training Level			
	Attending	—	—	
	Fellow	0.95	0.69, 1.30	0.7
	Resident	1.48	0.74, 2.83	0.3

(*Continued*)

Table 3 (Continued).

Group	Variable	Estimate[a]	95% CI	p-value
Operative Duration	Epic HCS	0.07	−0.14, 0.27	0.5
	Retinal/Optic Nerve Pathology	0.03	−0.78, 0.83	>0.9
	Ocular Surface Disease	1.0	0.20, 1.8	**0.015**
	Prior Ocular Surgery	1.0	−0.17, 2.2	0.093
	Complex Cataract	7.4	6.5, 8.4	**<0.001**
	Surgeon Training Level			
	Attending	—	—	
	Fellow	3.6	2.8, 4.3	**<0.001**
	Resident	1.1	−0.79, 3.0	0.3
Postoperative BCVA at 1 Month	Epic HCS	0.01	0.00, 0.02	0.2
	Retinal/Optic Nerve Pathology	0.17	0.13, 0.21	**<0.001**
	Ocular Surface Disease	0.04	0.00, 0.08	0.053
	Prior Ocular Surgery	0.07	0.01, 0.13	**0.016**
	Complex Cataract	0.10	0.06, 0.15	**<0.001**
	Surgeon Training Level			
	Attending	—	—	
	Fellow	0.00	−0.04, 0.04	>0.9
	Resident	0.12	0.03, 0.21	**0.013**

Notes: Logistic regression models report adjusted odds ratios (aOR) with 95% confidence intervals. Linear regression models report regression coefficients (β) with 95% confidence intervals. Epic HCS analyzed per 5-point increase. Same-day cancellation and anesthesia type models adjusted for Epic HCS and cataract complexity only. All other models adjusted for Epic HCS, retinal/optic nerve pathology, ocular surface disease, prior ocular surgery, cataract complexity, and surgeon training level. Bold values indicate statistical significance ($p<0.05$). [a]Estimates represent adjusted odds ratios (aOR) for logistic regression models and regression coefficients (β) for linear regression models.

Abbreviations: CI, Confidence Interval; HCS, health composite score; BCVA, best corrected visual acuity; MAC, monitored anesthesia care.

goodness-of-fit test (p = 0.86), which indicated adequate calibration. Cataract complexity classification did not predict cancellation risk in adjusted analysis (aOR=1.40; 95% CI, 0.72–2.58; p=0.3).

General anesthesia was used in 26 cases (2.2%), with similar rates across Epic HCS risk groups (p=0.13, Table 1). In multivariable analysis adjusting for cataract complexity, Epic HCS showed no association with anesthesia selection (aOR=1.04 per 5 point increase; 95% CI, 0.85–1.24; p=0.7) (Table 3). However, complex cataract classification showed a trend toward increased general anesthesia use (aOR=2.21; 95% CI, 0.93–4.93; p=0.059).

Operative duration also showed no statistically significant or clinically meaningful differences across HCS groups (p=0.063). (Table 2). In multivariable linear regression, the Epic HCS showed no association with operative time (β = +0.07 minutes per 5-point increase; 95% CI, −0.14 to +0.27; p=0.5) (Table 3). Instead, operative time was driven by complex cataract classification (β = +7.4 minutes; p<0.001), fellow-performed surgery (β = +3.6 minutes; p<0.001), and ocular surface disease (β = +1.0 minutes; p=0.015).

Surgical Outcomes

Surgical complications occurred in 100 patients (8.3%), with similar rates across HCS risk groups (7.1% vs 8.4% vs 9.2%; p=0.7). Prolonged postoperative inflammation occurred in 219 patients (18.2%), with rates of 13.8%, 19.7%, and

19% across low, medium, and high risk groups respectively (p=0.2) (Table 2). In multivariable analysis adjusting for ocular and surgical risk factors, the Epic HCS showed no significant association with major surgical complications (aOR = 1.09 per 5-point increase; 95% CI, 0.99–1.21; p=0.08) or prolonged postoperative inflammation (aOR = 1.03; 95% CI, 0.95–1.11; p=0.5) (Table 3). Although the association with complications approached significance, a model without HCS achieved nearly identical discrimination (AUC 0.705 vs. 0.712; likelihood ratio test p=0.086), indicating that HCS provided negligible incremental predictive value beyond procedure-specific risk factors. Indeed, significant predictors for surgical complications included complex cataract classification (aOR = 3.25; 95% CI, 2.08–5.03; p<0.001), prior ocular surgery (aOR = 2.20; 95% CI, 1.23–3.80; p=0.006), and fellow-performed surgery (aOR = 1.96; 95% CI, 1.26–3.06; p=0.003). For prolonged inflammation, independent predictors included complex cataract classification (aOR = 1.71; 95% CI, 1.19–2.43; p=0.004) and retinal or optic nerve pathology (aOR = 1.50; 95% CI, 1.10–2.05; p=0.01).

Visual Outcomes

Postoperative visual acuity did not differ by HCS group (p=0.8) (Table 2). In multivariable linear regression, the Epic HCS was not associated with postoperative BCVA (β = +0.01 logMAR per 5-point increase; 95% CI, 0.00–0.02; p=0.2). Independent predictors of postoperative BCVA were retinal or optic nerve pathology (β = +0.17; 95% CI, 0.13–0.21; p<0.001), prior ocular surgery (β = +0.07; 95% CI, 0.01–0.13; p=0.016), complex cataract classification (β = +0.10; 95% CI, 0.06–0.15; p<0.001), and resident surgeon (β = +0.12; 95% CI, 0.03–0.21; p=0.013) (Table 3).

Discussion

As expected, patients with higher Epic HCS demonstrated characteristics associated with greater systemic health burden. Higher-risk patients were more likely to be older and have increased prevalence of diabetes and hypertension (all p<0.05), conditions that contribute directly to the HCS calculation. Black patients were disproportionately represented in higher HCS categories, consistent with well-documented health disparities arising from social determinants of health.[21] The observed association between higher HCS and surgery performed by residents and fellows likely reflects the patient population characteristics of resident-staffed clinics, which serve a higher proportion of patients with systemic comorbidities and healthcare access challenges.

The Epic HCS independently predicts same-day surgical cancellation in cataract surgery patients, with each 5-point increase associated with 23% higher odds of cancellation and high-risk patients experiencing more than double the cancellation rate compared to low-risk patients. This finding supports the utility of automated EHR-based risk stratification for preoperative triage and care coordination. The overall cancellation rate of 4.4% in this cohort falls within the 0.5–8% range reported across elective and ambulatory surgical settings, and represents a clinically significant source of operating room inefficiency and patient burden.[9,22,23] The association likely reflects the combined contribution of the score's components to perioperative coordination challenges, such as recent hospitalizations and emergency department visits, chronic disease burden, active medications, and care fragmentation. Chronic conditions such as congestive heart failure, renal disease, diabetes with complications, and liver disease have been identified as strong predictors of same-day cancellation in prior studies, with medical issues including abnormal laboratory values, cardiac concerns, hyperglycemia, and uncontrolled hypertension accounting for the majority of cancellations.[24] These systemic comorbidities create cascading coordination challenges that are amplified by care fragmentation and polypharmacy. Care fragmentation, measured by the number of unique providers seen, reflects the absence of coordinated perioperative decision-making and has been linked to increased postoperative readmission mortality, higher complication rates, and poor care coordination.[25–27] In the perioperative setting, fragmentation may manifest as conflicting recommendations regarding anticoagulation, incomplete medical clearance, or delayed communication between providers. Polypharmacy increases the likelihood of drug-drug interactions, inappropriate medication continuation or discontinuation, and uncertainty regarding which agents should be held preoperatively.[28,29] Together, these indicators of medical complexity and healthcare utilization increase the likelihood of last-minute barriers preventing elective surgery.

These findings have important implications for preoperative workflow optimization and resource allocation. Same-day surgical cancellations represent a major source of inefficiency and financial loss, with estimates suggesting costs of approximately $1400–$1700 per operating room hour and an average cost of $379 per cancelled ophthalmic case, excluding downstream costs related to rescheduling and repeated preoperative testing.[30] In ambulatory ophthalmic settings, late cancellations have been estimated to result in institutional losses exceeding $100,000 annually, corresponding to nearly one month of lost operating room

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capacity over a two-year period.[9] Prior literature suggests that 37–41% same-day cancellations are preventable with improved preoperative counseling and assessment, framing cancellation as an actionable quality measure rather than an unavoidable consequence of patient illness.[9,22]

The Epic HCS may offer a mechanism to systematically identify at-risk patients at the time of surgical scheduling rather than on the day of surgery. Institutions could integrate automated alerts for high-risk patients (eg, HCS > 20) at the time of surgical scheduling to prompt proactive care coordination including earlier anesthesiology consultation, enhanced medication reconciliation, laboratory testing, and coordinated communication among fragmented providers. Such workflows have been shown in other specialties to reduce cancellation rates and improve operating room efficiency.[31] The Epic HCS also offers practical advantages over traditional clinician-assigned risk scores such as the ASA Physical Status Classification in this context. Unlike ASA, which requires manual assignment and is subject to considerable inter-rater variability, the Epic HCS is automatically generated from structured EHR data at the time of scheduling, enabling proactive identification of at-risk patients.[32] Additionally, the score updates dynamically as new diagnoses or encounters are documented, allowing ongoing reassessment of perioperative risk without requiring additional clinical time or resources.

Prospective validation across diverse clinical settings will be essential before widespread adoption of triage guided by the HCS. The current findings are derived from a single academic medical center with a specific patient population and surgical workflow. The utility of Epic HCS may differ in community-based practice settings or institutions with different patient demographics, resources, and surgical volumes. Given that Epic is among the most widely deployed EHR platforms in the United States, the HCS is a suitable candidate for multicenter prospective evaluation. Future studies should evaluate whether HCS-triggered interventions meaningfully reduce cancellation rates and improve operative room efficiency, as measured by operating room utilization rate, turnover times, and first-case on-time start rates. Additionally, given the disproportionate representation of Black patients in higher HCS categories, triage triggering additional preoperative requirements or delaying scheduling could inadvertently create systemic barriers to timely care for populations already facing healthcare access challenges. Interventions should therefore be designed to facilitate care coordination rather than restrict access, and that equity metrics should be monitored alongside efficiency outcomes.

The moderate discriminative ability of the Epic HCS in predicting same-day cancellations (AUC = 0.632) reflects the multifactorial nature of cancellation risk. Unlike postoperative complications, which are more directly linked to physiologic status and where automated EHR scores achieve AUCs of 0.75–0.8, same-day cancellations arise from a broader constellation of medical, operational, and social factors incompletely captured by structured EHR data.[2,4] These include scheduling errors, insurance issues, noncompliance with preoperative instructions, or transportation barriers.[22,24]

Importantly, the Epic HCS did not predict surgical outcomes after patients were cleared for surgery. The HCS showed no association with anesthesia type selection, operative duration, surgical complications, prolonged postoperative inflammation, or visual acuity. General anesthesia was rare (2.2%) and likely driven more by procedural factors and patient-specific considerations such as cooperation, claustrophobia, or cognitive impairment rather than systemic comorbidity.[12] Surgical outcomes and operative duration were consistently predicted by ophthalmic-specific factors including complex cataract classification, prior ocular surgery, retinal or optic nerve pathology, as well as surgeon training level. This pattern aligns with prior literature that cataract surgery outcomes are driven primarily by ocular anatomy such as lens density, zonular integrity, pupil size, and tissue vulnerability rather than systemic medical comorbidity.[33] The lack of association between HCS and other surgical outcomes positions the Epic HCS as a perioperative triage tool rather than a surgical prognostic tool.

This study has several limitations. As a single-center retrospective cohort at an academic medical center, the findings may not be generalizable to community practice settings with different patient populations or surgical workflows. This design is susceptible to selection bias, confounding, and reliance on historically recorded data, which may be incomplete or inconsistent. The Epic HCS was extracted at the time of data collection rather than at the time of surgery, and may therefore reflect clinical events that occurred after the surgical date, introducing potential temporal bias. The study was adequately powered to detect the observed association between HCS and same-day cancellation but was underpowered to detect the small effect sizes observed for surgical complications (aOR = 1.09; power = 35%) and prolonged inflammation (aOR = 1.03; power = 11%). However, even if these associations achieved significance in a larger sample, the magnitude of effect would be of limited clinical relevance for individual patient risk stratification. Additionally, the proprietary nature of the Epic HCS algorithm further limits full transparency and reproducibility, as specific component weights are not publicly available. The cohort was limited to phacoemulsification, and

HCS performance may differ for more complex ophthalmic procedures or in other surgical specialties. Finally, specific reasons for same-day cancellation were not documented, limiting the ability to distinguish medical or anesthesia-related cancellations from administrative or patient-driven causes.

Conclusion

The Epic HCS independently predicting same-day surgical cancellation but not surgical or visual outcomes in cataract surgery supports its role as a perioperative triage tool rather than a surgical prognostic instrument. However, the moderate discriminative performance of the score (AUC = 0.632) illustrates that cancellation risk is multifactorial and not fully captured by structured EHR data alone, and the HCS should complement rather than replace traditional ophthalmic risk assessment. As healthcare systems increasingly emphasize operational efficiency, cost reduction, and patient-centered care, future research should focus on prospective implementation of Epic HCS-guided care pathways, intervention efficacy for reducing cancellations, and integration with patient-reported and social determinant factors to achieve more comprehensive perioperative risk assessment.

Abbreviations

AC, anterior chamber; aOR, adjusted odds ratio; ASA, American Society of Anesthesiologists; AUC, area under the receiver operating characteristic curve; BCVA, best-corrected visual acuity; BMI, body mass index; CI, confidence interval; EHR, electronic health record; GA, general anesthesia; HCS, Health Composite Score; IRB, Institutional Review Board; logMAR, logarithm of the minimum angle of resolution; MAC, monitored anesthesia care; POM, postoperative month; UNC, University of North Carolina.

Data Sharing Statement

Available upon reasonable request to corresponding author.

Ethics Approval and Informed Consent

This study was approved by the University of North Carolina Institutional Review Board (IRB #25-1155). Due to the retrospective nature of this study and minimal risk to participants, the requirement for informed consent was waived.

Consent for Publication

Not applicable. This manuscript does not contain any individual person's data in any form.

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Disclosure

The authors report no conflicts of interest in this work.

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