

Predictive Index for 90-Day Postoperative Outcomes Following Gynecologic Surgery

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The optimization of surgical care and disposition planning continues to be relevant for surgeons and patients. Readmissions to the hospital are a major source of patient dissatisfaction¹ and a leading cause of health care expenditures, with readmission costs accounting for more than \$12 billion per year.^{2,3} This issue is particularly concerning for surgical patients, with a prior investigation showing that 27% of Medicare and Medicaid patients were readmitted within 90 postoperative days.² Hospital readmissions are utilized by CMS as a marker of quality of care.³ As hospitals are incentivized to reduce readmissions, optimized patient transitions of care have become an essential component of effective care delivery. A potential opportunity to improve upon surgical care and discharge planning is through appropriately engaging resources to support high-risk patients, hence decreasing preventable hospital readmissions.

Due to a moderate rate of hospital readmissions and postoperative complications, gynecologic surgery is of particular interest for evaluating methods for improving surgical care and discharge planning. Readmissions in this population predominately result from wound infection and peritoneal adhesions leading to bowel obstruction, infertility, and pain.⁴⁻⁶ Prior work in the literature reports that following gynecologic surgery, readmission rates range from 1.4% to 34.2%⁵⁻⁹ and postoperative complication rates range from 8% to 21%.^{7,10,11} Independent risk factors for readmission identified by previous studies are severity of preoperative medical comorbidities, prolonged operative time, and postoperative complications.⁹ However, there is currently no validated tool to predict a patient's risk of 90-day readmission at the time of discharge for the gynecologic surgery population.

The LACE (Length of stay [LOS], Acuity of admission, Charlson Comorbidity Index [CCI] score, and Emergency department [ED] visits in the past 6 months) index was developed to predict readmissions among hospital discharges/medical patients.¹² The LACE index has been assessed in various surgical populations and disease-specific medical populations, such as congestive heart failure and chronic obstructive pulmonary disease, with mixed results to date. In an attempt to expand upon the LACE index, Van Walraven et al

ABSTRACT

OBJECTIVES: Assessment of the potential of LACE+ index scores in patients undergoing gynecologic surgery to predict short-term undesirable outcomes.

STUDY DESIGN: Retrospective study over a 2-year time period (2016-2018).

METHODS: Coarsened exact matching was used to assess the predictive capacity of the LACE+ index among all gynecologic surgery cases over a 2-year period (2016-2018) at 1 health system (N = 12,225). Study subjects were matched on characteristics not assessed by LACE+, including race and duration of surgery. For comparison of outcomes, LACE+ score was divided into quartiles and otherwise matched populations were compared in reference to LACE+ quartile (Q): Q4 vs Q1, Q4 vs Q2, Q4 vs Q3.

RESULTS: A total of 1715 patients were matched for Q1 to Q4, 1951 patients were matched for Q2 to Q4, and 1822 patients were matched for Q3 to Q4. Escalating LACE+ score significantly predicted increased readmission, reoperation, and emergency department (ED) visits from 30 to 90 postoperative days as well as readmission, reoperation, and ED visits from 0 to 90 postoperative days.

CONCLUSIONS: The results of this study suggest that the LACE+ index is suitable as a prediction model for important patient outcomes in a gynecologic surgery population.

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TAKEAWAY POINTS

The present study assessed the ability of the LACE+ index to identify patients at risk of adverse outcomes after gynecologic surgery.

- ▶ Patients with highest quartile LACE+ scores were nearly 3 times more likely to be readmitted than patients with the lowest LACE+ scores. Outcomes were similar with respect to rates of reoperation and emergency department visits.
- ▶ The LACE+ index has shown utility in identifying patients at increased risk of suboptimal postoperative outcomes.
- ▶ Future studies will target ways to pursue targeted interventions designed to improve postdischarge outcomes.

assessed a LACE+ index (Figure 1) that captures additional variables such as age, sex, and other covariates to expand the accuracy of the model.¹³ None of the prior reports in the literature evaluated readmission patterns in a gynecologic surgical population. In an attempt to minimize confounding factors, the study herein utilizes coarsened exact matching to assess the predictive capacity of LACE+ for gynecologic surgery patients. Coarsened exact matching, per its creator, is “a monotonic imbalance bounding matching method which balances between the treated and control groups by the user ex ante rather than discovered through the usual laborious process of checking after the fact and repeatedly reestimating”¹⁴ (Figure 2 [A]). The objective of this study was to determine, in a preliminary analysis, if the LACE+ index has the potential of being leveraged for postoperative management of a population of patients undergoing an array of gynecologic surgeries.

METHODS

Sample Selection

In this University of Pennsylvania institutional review board (IRB)-approved study (approval number 831722), patients undergoing gynecologic surgical intervention at a multihospital, 1659-bed university health system were enrolled retrospectively over 2 years (January 1, 2016, to January 1, 2018). A waiver of informed consent was granted by the IRB because this study was considered to be of minimal risk to patients. A total of 12,225 gynecologic procedures were studied (Figure 2 [B]). Key data were acquired using the EpiLog tool, a nonproprietary data acquisition system built and layered on top of the existing electronic health record architecture to enhance charting, workflow, quality improvement efforts, and cost reduction (by the senior author [N.R.M.] of this article and his department).¹⁵⁻²¹

Data Collection

Relevant patient information including sex, admission type, LOS, CCI score, alternative level of care (ALC) status, recent ED visits, surgical history, and history of hospital admissions was scored and incorporated into a composite LACE+ index value (−2 to 90).

Patient characteristics not used for LACE+ index score calculation served as matching criteria. Included were operative duration, surgery type (elective, emergent, urgent), surgical cost, median household

income, insurance type (private, government, workers' compensation), wound class (clean or contaminated), admission type (routine, emergency, transfer) and patient class (inpatient, outpatient), as well as median household income²² and cost of surgical supplies and implants (Table 1). Outcomes for patients from each LACE+ quartile were then analyzed and compared with matched patients in the fourth quartile (ie, those patients with the highest LACE+ scores). Other characteristics were recorded, such as body mass index (BMI), history of prior lifetime surgery, and surgery within 90 days before the operation. Lastly, mortality during the 90-day follow-up period, as well as occurrence of 90-day readmission, ED visit, and reoperation, were recorded.

Statistical Analysis

Matches were sought between patients with different LACE+ score quartiles but otherwise identical characteristics (matching criteria) (eAppendix Figure [eAppendix available at ajmc.com]). During this process, patients in the highest LACE+ score quartile (Q4) were matched to patients in lower LACE+ score quartiles (Q3, Q2, Q1). Unmatched patients from each LACE+ quartile were removed from the data set and not included in further analysis. The result was a series of matched groups (Q4-Q1, Q4-Q2, Q4-Q3). Groups in these pairs differed only with respect to LACE+ score and had otherwise identical patient composition.

McNemar's test was used to assess the ability of the LACE+ index and subsequent single variables to accurately predict the outcome measures by comparing the means between groups created via coarsened exact matching. Univariate analysis was performed with significance set at $P < .05$. Data were extracted from EpiLog and pushed into defined spreadsheets. Binning of the matching variables and removal of missing values were performed using SAS version 9.4 (SAS Institute Inc). Matching was completed using the MatchIt programming package²³ in R Statistics (R Core Team), with subsequent analysis executed through SAS version 9.4.

RESULTS

Patient Characteristics

The sample included all consecutive patients undergoing gynecologic surgery over 2 calendar years ($N = 12,225$) (Table 1). Median BMI was 29.65. Median LOS was 31 hours, and median operative duration was 48 minutes for all patients. Median total cost of surgical supplies and implants was \$115.51. Median household income for patients was \$65,123 for the overall cohort.

Patient Outcomes

Q1 to Q4 comparison. For the Q1 to Q4 comparison, 1715 patients were matched ($n = 3430$; a 66.3% match rate) (Table 2). Among matched patients, escalating LACE+ score significantly predicted increased

readmission from 30 to 90 postoperative days (0.41% vs 1.05%; odds ratio [OR], 2.57; 95% CI, 1.07-6.16; $P = .028$) and ED visits from 30 to 90 days (2.57% vs 6.18%; OR, 2.55; 95% CI, 1.77-3.68; $P < .001$) (Figure 3 [A]). Increasing LACE+ score predicted higher rates of readmission, reoperation, and ED visits from 0 to 90 postoperative days (readmission: 2.27% vs 4.26%; OR, 1.94; 95% CI, 1.30-2.91; $P = .001$; reoperation: 0.58% vs 1.58%; OR, 2.70; 95% CI, 1.31-5.58; $P = .005$; ED visits: 7.58% vs 13.88%; OR, 1.93; 95% CI, 1.54-2.42; $P < .001$) (Figure 3 [B]). Escalating LACE+ score did not predict higher rates of reoperation from 30 to 90 postoperative days (OR, 2.00; 95% CI, 0.54-9.08; $P = .388$).

Q2 to Q4 comparison. For the Q2 to Q4 comparison, 1951 patients were matched ($n = 3902$; a 63.3% match rate) (Table 2). Among matched patients, escalating LACE+ score significantly predicted increased readmission from 30 to 90 postoperative days (0.41% vs 1.64%; OR, 4.00; 95% CI, 1.84-8.68; $P < .001$), reoperation from 30 to 90 days (0.21% vs 0.87%; OR, 4.25; 95% CI, 1.43-12.63; $P = .008$), and ED visits from 30 to 90 days (2.31% vs 6.15%; OR, 2.79; 95% CI, 1.96-3.96; $P < .001$) (Figure 3 [A]). Increasing LACE+ score significantly predicted higher rates of readmission, reoperation, and ED visits from 0 to 90 postoperative days (readmission: 2.26% vs 5.33%; OR, 2.46; 95% CI, 1.71-3.54; $P < .001$; reoperation: 0.72% vs 1.64%; OR, 2.29; 95% CI, 1.22-4.28; $P = .008$; ED visits: 7.74% vs 14.20%; OR, 2.02; 95% CI, 1.63-2.51; $P < .001$) (Figure 3 [B]).

Q3 to Q4 comparison. For the Q3 to Q4 comparison, 1822 patients were matched ($n = 3644$; a 59.0% match rate) (Table 2). Among matched patients, escalating LACE+ score significantly predicted increased ED visits from 30 to 90 postoperative days (2.25% vs 5.88%; OR, 2.69; 95% CI, 1.86-3.89; $P < .001$) (Figure 3 [A]). Increasing LACE+ score significantly predicted higher rates of readmission from 0 to 90 postoperative days (4.17% vs 5.98%; OR, 1.48; 95% CI, 1.09-2.01; $P = .012$) and ED visits from 0 to 90 postoperative days (5.65% vs 14.38%; OR, 2.92; 95% CI, 2.27-3.74; $P < .001$) (Figure 3 [B]). Escalating LACE+ score did not predict higher rates of readmission or reoperation from 30 to 90 postoperative days (readmission: OR, 1.54; 95% CI, 0.94-2.52; $P = .085$; reoperation: OR, 1.73; 95% CI, 0.92-3.27; $P = .086$). In addition, LACE+ score did not predict a higher rate of reoperation within 90 postoperative days (OR, 1.26; 95% CI, 0.79-2.02; $P = .339$).

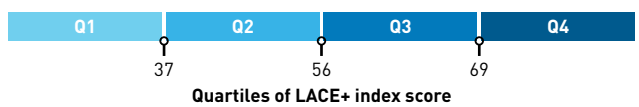
DISCUSSION

Escalating LACE+ score, among otherwise matched patients, appears to effectively predict numerous undesirable outcomes for patients undergoing gynecologic surgery interventions. The primary objective of this study was to evaluate the predictive ability of the LACE+ index on a number of patient outcomes in a gynecologic surgery population. Through comparison of the LACE+ index between otherwise matched Q1 and Q4 patients, the results of this study demonstrate that increasing LACE+ score predicts higher rates of hospital readmission, need for reoperation, and visits to the ED at 0 to 90 postoperative days. These data additionally suggest a significant difference in readmission and ED visit rates from 30 to 90 postoperative days. Escalating LACE+ index score led to a

FIGURE 1. LACE+ Score Components*

Predictor	Points
Male sex	3
Urgent admission	15
Discharge institution	
Teaching hospital/small nonteaching hospital	0
Large nonteaching hospital	-1
Length of stay in days	
< 1	0
1	2
2	3
3	4
4	5
5-6	6
7-10	7
> 10	9
No. of days on ALC status	
0	0
> 0	-1
No. of ED visits in previous 6 months	
0	0
1	3
> 1	6
No. of elective admissions in past year	
0	0
> 0	6

Age in years	Previous urgent admissions = 0			Previous urgent admissions > 0		
	CCI score 0	CCI score 1	CCI score > 1	CCI score 0	CCI score 1	CCI score > 1
< 32	0	10	30	25	33	48
32-40	2	12	31	26	34	48
41-46	5	15	34	27	35	49
47-52	7	16	34	28	35	48
53-58	9	17	35	29	35	48
59-64	12	29	38	39	36	49
65-69	15	23	40	32	38	50
70-75	18	26	42	33	39	50
76-80	20	27	42	35	40	50
> 80	27	33	47	38	42	51

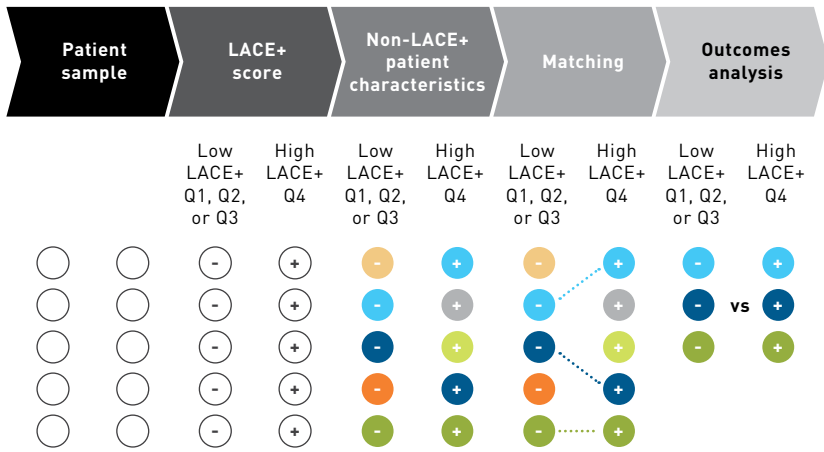


ALC, alternative level of care; CCI, Charlson Comorbidity Index; ED, emergency department; Q, quartile.

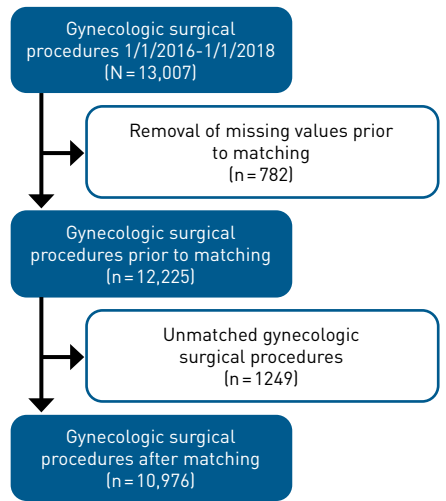
*Score sheet that demonstrates the components of the LACE+ index and their numerical weights, with breakdown of LACE+ index quartiles.

FIGURE 2. Matching and Patient Selection

A. Coarsened exact matching process^a



B. Flowchart of patient selection^b



^aSchematic overview of the process used for coarsened exact matching.

^bOutlined are the number of patients included and excluded based on specific criteria.

1.9-fold increased risk of 0-to-90-day readmission in the Q1 vs Q4 comparison, a 2.5-fold increase in the Q2 vs Q4 comparison, and a 1.5-fold increase in the Q3 vs Q4 comparison. These results build upon those of prior studies that report on the predictive capability of the LACE index for readmissions.

Integrating a prediction model into the electronic health record, with the ability to assist in postsurgical care planning, is essential for reducing readmissions. Although the LACE and LACE+ indices provide the ability to curtail the abundance of patient data into a simple value, they have fallen short in numerous studies.²⁴⁻²⁶ The results of the study herein demonstrate that the LACE+ index may be suitable as a prediction model for readmission in a gynecologic surgery population. Through coarsened exact matching, these results offer increased assurance that successful application of the LACE+ index is not a result of variables outside the scope of the LACE+ covariates. In the present study, well-matched patients, when compared by LACE+ quartile, had multiple outcomes that were significant both clinically and statistically.

Postoperative peritoneal adhesions are the primary concern in gynecologic surgery patients and the leading cause of hospital readmission in this population.⁴ The Surgical and Clinical Adhesions Research Group found, in a number of studies, that patients undergoing ovarian surgery had a 7.5% readmission rate due to peritoneal adhesions.^{4,6} Additionally, these investigations found that roughly one-third of patients who underwent open pelvic surgery were readmitted over the subsequent 10 years, with greater than 20% of readmissions occurring during the first year after surgery.⁴⁻⁶ Further, there is evidence that preoperative factors have an impact on readmission rates following gynecologic procedures. A 2017

TABLE 1. Patient Demographics and Baseline Characteristics^a

Demographic/baseline characteristic, n (%)	Q1-Q4 matched patients (n = 3430)	Q2-Q4 matched patients (n = 3902)	Q3-Q4 matched patients (n = 3644)
Race			
White	1356 (39.53)	1744 (44.70)	1972 (54.12)
African American	1482 (43.21)	1540 (39.47)	1223 (33.56)
Asian	153 (4.46)	192 (4.92)	125 (3.43)
Hispanic/Latino	278 (8.11)	267 (6.84)	171 (4.69)
American Indian	4 (0.12)	2 (0.05)	1 (0.03)
East Indian	28 (0.82)	32 (0.82)	21 (0.58)
Pacific Islander	11 (0.32)	8 (0.21)	6 (0.16)
Other	73 (2.13)	73 (1.87)	75 (2.05)
Unknown	45 (1.31)	44 (1.13)	50 (1.37)
Mortality during follow-up	9 (0.26)	8 (0.21)	20 (0.55)
BMI			
< 18.5	14 (0.41)	10 (0.26)	12 (0.33)
18.5-29.9	1610 (46.94)	1798 (46.08)	1822 (50.00)
≥ 30	1806 (52.65)	2094 (53.66)	1810 (49.67)
Insurance type			
Commercial	80 (2.33)	85 (2.18)	50 (1.37)
Medicare	127 (3.70)	158 (4.05)	671 (18.41)
Medicaid	1204 (35.10)	1055 (27.04)	650 (17.84)
Managed care	1698 (49.50)	2220 (56.89)	1900 (52.14)
Self-pay	49 (1.42)	37 (0.95)	19 (0.52)
Blue Cross	272 (7.93)	347 (8.89)	354 (9.71)

(continued)

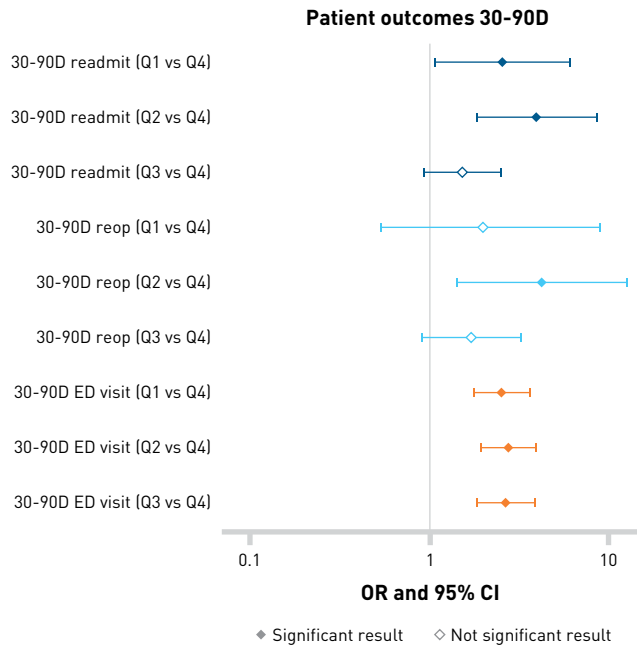
TABLE 1. (Continued) Patient Demographics and Baseline Characteristics*

Demographic/baseline characteristic, n (%)	Q1-Q4 matched patients (n = 3430)	Q2-Q4 matched patients (n = 3902)	Q3-Q4 matched patients (n = 3644)
Admission type			
Routine scheduled	2146 [62.57]	2934 [75.19]	3007 [82.52]
Emergency	165 [4.81]	178 [4.56]	166 [4.56]
Transfer	11 [0.32]	13 [0.33]	14 [0.38]
Routine unscheduled	157 [4.58]	132 [3.38]	79 [2.17]
Other	951 [27.73]	645 [16.53]	378 [10.37]
CCI score			
0	2241 [65.34]	2354 [60.33]	1164 [31.94]
1	757 [22.07]	870 [22.30]	832 [22.83]
2	144 [4.20]	241 [6.18]	455 [12.49]
3	72 [2.10]	127 [3.25]	364 [9.99]
4	50 [1.46]	86 [2.20]	256 [7.03]
5	33 [0.96]	42 [1.08]	160 [4.39]
6	44 [1.28]	59 [1.51]	113 [3.10]
7	27 [0.79]	47 [1.20]	93 [2.55]
8	22 [0.64]	29 [0.74]	77 [2.11]
9	14 [0.41]	18 [0.46]	55 [1.51]
10	8 [0.23]	15 [0.38]	37 [1.02]
11	7 [0.20]	7 [0.18]	20 [0.55]
12	5 [0.15]	3 [0.08]	8 [0.22]
13	5 [0.15]	2 [0.05]	6 [0.16]
14	0 [0.00]	1 [0.03]	2 [0.05]
15	0 [0.00]	0 [0.00]	0 [0.00]
16	1 [0.03]	1 [0.03]	2 [0.05]
Number of other surgical interventions within 30 days prior to surgery			
0	3355 [97.81]	3820 [97.90]	3503 [96.13]
≥ 1	75 [2.89]	82 [2.10]	141 [3.87]
Number of other lifetime surgical interventions prior to surgery			
0	2763 [80.55]	2930 [75.09]	2516 [69.05]
≥ 1	667 [19.45]	972 [24.91]	1128 [30.95]
Incision site contaminant status			
Clean	446 [13.00]	632 [16.20]	580 [15.92]
Clean contaminated	2960 [86.30]	3250 [83.29]	3032 [83.21]
Dirty	24 [0.70]	14 [0.36]	28 [0.77]
Surgery type			
Elective	2550 [74.34]	3200 [82.01]	3193 [87.62]
Emergent	880 [25.66]	702 [17.99]	451 [12.38]
Patient class			
Inpatient	2100 [61.22]	2002 [51.31]	1530 [41.99]
Outpatient	1330 [38.78]	1898 [48.64]	2112 [57.96]
Emergency	0 [0.00]	2 [0.05]	2 [0.05]

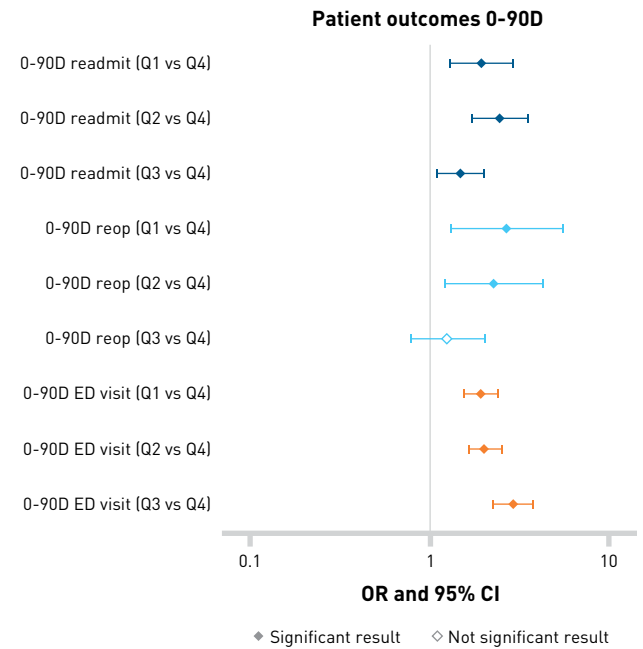
BMI, body mass index; CCI, Charlson Comorbidity Index; Q, quartile.
 *Overview of patient characteristics in each matched quartile group.

FIGURE 3. LACE+ Score Interquartile Comparison

A. 30-90D LACE+ score interquartile comparison*



B. 0-90D LACE+ score interquartile comparison*



0-90D, 0-to-90-day; 30-90D, 30-to-90-day; ED, emergency department; OR, odds ratio; Q, quartile; readmit, readmission; reop, reoperation.
 *ORs and 95% CIs for patient outcomes in the 30-90D postoperative window (significance set at P = .05).
 *ORs and 95% CIs for patient outcomes at 90 postoperative days (significance set at P = .05).

TABLE 2. Patient Outcomes and Complications^a

Outcome/ complication	Q1-Q4 matched patients		Q2-Q4 matched patients		Q3-Q4 matched patients	
	LACE+ Q1 n (%)	LACE+ Q4 n (%)	LACE+ Q2 n (%)	LACE+ Q4 n (%)	LACE+ Q3 n (%)	LACE+ Q4 n (%)
30-to-90-day readmission	7 (0.41)	18 (1.05)	8 (0.41)	32 (1.64)	26 (1.43)	40 (2.20)
	P = .028		P < .001		P = .085	
30-to-90-day reoperation	4 (0.23)	8 (0.47)	4 (0.21)	17 (0.87)	15 (0.83)	26 (1.43)
	P = .388		P = .007		P = .086	
30-to-90-day ED visit	44 (2.57)	106 (6.18)	45 (2.31)	120 (6.15)	41 (2.25)	107 (5.88)
	P < .001		P < .001		P < .001	
0-to-90-day readmission	39 (2.27)	73 (4.26)	44 (2.26)	104 (5.33)	76 (4.17)	109 (5.98)
	P = .001		P < .001		P = .011	
0-to-90-day reoperation	10 (0.58)	27 (1.58)	14 (0.72)	32 (1.64)	33 (1.82)	41 (2.26)
	P = .005		P = .008		P = .339	
0-to-90-day ED visit	130 (7.58)	238 (13.88)	151 (7.74)	277 (14.20)	103 (5.65)	262 (14.38)
	P < .001		P < .001		P < .001	

ED, emergency department; Q, quartile.

^aP values represent appropriate statistical test comparing respective quartiles of LACE+ score (significance set at P = .05). Bold text denotes statistically significant result.

study by Cory et al found a 2.8-fold increased risk for readmission for patients receiving surgical treatment for oncologic conditions compared with those treated for benign conditions.⁹ Adhesion-related health care costs also carry a tremendous financial burden, totaling in excess of \$1 billion annually.^{4,27} As evidenced by the CMS homing in on readmissions as a target for reducing health care cost, it is clear that reducing readmission rates is in the interest of the health care system, the hospital, and the patient. The current literature on patients receiving gynecologic surgery establishes that preoperative factors and postoperative complications play a significant role in hospital readmissions²⁸; thus, these factors need to be considered in attempts at discharge planning.

The results of this large and coarsened exact matched gynecologic surgery cohort study show that the LACE+ index can be used as an effective predictor of short-term patient outcomes. This suggests that the LACE+ index has potential utility to assist in appropriately engaging resources toward programs focused on reducing readmissions, such as shorter intervals between follow-up appointments or in-home assistance, but this necessitates further investigation. For example, rather than sending in-home nursing care to Q1 and Q4 patients for an equivalent amount of time, nursing care could be sent more frequently to the Q4 cohort, shown to be at high risk of readmission. The ability to reduce Q4 readmissions without increasing Q1 readmissions represents a powerful example of low-cost health care improvement, with minimal workflow interruption, through applying predictive measures.

This study was designed to elucidate the capacity of the LACE+ index to discern differences between groups. The LACE+ index is a risk score; therefore, patients who have similar risk profiles (Q3 and Q4) are less likely to have significant differences in outcomes. However, this study provides valuable data regarding population management

for the highest-risk, Q4 patients. Expanded, prospective studies to assess outcome differences between each of the quartiles are a target of future investigation, which the authors plan to pursue. The study herein was able to differentiate significant outcomes between quartiles of LACE+ index score, which suggests that effective prediction and application for optimal resource engagement is possible using this tool.

Limitations

Potential inaccuracies in data recording may have influenced the analysis and contributed to inherent selection bias. However, one benefit of coarsened exact matching is that these hypothetical inaccuracies would be equally distributed among comparison groups. The study design is also reliant on the index university hospital system as the recipient institution for the readmissions to be recorded in the electronic health record. This means that the true readmission rate could potentially be underreported, creating challenges for the LACE+ index to accurately fit the sample. In addition, there is a slight limit in generalizability because this sample was selected from 1 institution.

Further, although patients were matched on many key criteria, it is possible that in the population being studied, additional criteria might have resulted in more perfect matches. The matching criteria were selected based on supporting literature correlating these factors with outcomes. Prior investigations on length of surgery have shown that an increase in surgical time leads to increased risk of complication and predicts length of surgical intensive care unit stay.^{29,30} History of previous surgery, evaluated in abdominal surgery³¹ and cervical spine surgery,³² was found to lower surgical success rate and postoperative improvement. Connolly et al found that uninsured and Medicaid patients incurred increased odds of postsurgical inpatient mortality.³³ This result was similarly found in patients with low income status following lung cancer resection.³⁴ Numerous studies have reported minority race,^{35,36} BMI (particularly obesity),³⁷⁻³⁹ and case type^{40,41} as being independently associated with increased postoperative morbidity.

Future studies should expand the use of the LACE+ index in a larger, perhaps multicenter, gynecologic population that may prove robust enough for the accuracy of the LACE+ index to be definitively assessed. Additionally, a prospective trial using the LACE+ index to inform resource allocation could offer further conclusive results.

CONCLUSIONS

The results of the study herein are novel, as this is the first report in the literature of studying the LACE+ index in gynecologic

surgery. The utility of a predictive tool, such as the LACE+ index, to forecast readmissions has the potential to generate reductions in avoidable readmissions that cause substantial economic strain and inhibit patient recovery. Our results show that the LACE+ index, when evaluated in a coarsened exact matched cohort, is a valuable predictive model when applied to the gynecologic surgery population. Although there appears to be evidence supporting the use of the LACE+ index as it stands in this population, future research should aim to expand the population analyzed by LACE+ and study its utility in a prospective manner. ■

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eAppendix Figure. Coarsened Exact Matching Criteria

- 1. Operative Duration**
 - a. Median = 48 Minutes
- 2. Total Cost of Surgical Supplies and Implants**
 - a. Median = \$115.51
- 3. Insurance Provider**
 - a. Private = Commercial, Managed Care, Blue Cross
 - b. Government = Medicare, Medicaid, Self-Pay, Other
 - c. Worker's Comp
- 4. Race**
 - a. White
 - b. Non-White = African American, Asian, Hispanic/Latino, American Indian, East Indian, Pacific Islander, Other, Unknown
- 5. BMI**
 - a. Cachexia = BMI < 18.5
 - b. Normal = BMI between 18.5 and 30
 - c. Obese = BMI > 30
- 6. Wound Class**
 - a. Exact match
- 7. Patient Class (Inpatient/Outpatient)**
 - a. Exact match
- 8. Median Income (MHI)**
 - a. Median = \$65,123

Details the specific variables used for match patients during coarsened exact matching.