Patients undergoing colorectal surgery at a Veterans Affairs Hospital do not experience racial disparity in length of stay either before or after implementing an enhanced recovery pathway

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Abstract

Background: Enhanced Recovery Pathways (ERP) have been shown to reduce racial disparities following surgery. The objective of this study is to determine whether ERP implementation mitigates racial disparities at a Veterans Affairs Hospital.

Methods: A retrospective cohort study was conducted using data obtained from the Veterans Affairs Surgical Quality Improvement Program. All patients undergoing elective colorectal surgery following ERP implementation were included. Current procedural terminology (CPT) codes were used to identify patients who underwent similar procedures prior to ERP implementation.

Results: Our study included 417 patients (314 pre-ERP vs. 103 ERP), 97.1% of which were male, with an average age of 62.32 (interquartile range (IQR): 25–90). ERP patients overall had a significantly shorter post-operative length of stay (pLOS) vs. pre-ERP patients (median 4 days (IQR: 3–6.5) vs. 6 days (IQR: 4–9) days (p < 0.001)). Within the pre-ERP group, median pLOS for both races was 6 days (IQR: 4–6; p < 0.976) and both groups experienced a decrease in median pLOS (4 vs. 6 days; p < 0.009 and p < 0.001) following ERP implementation.

Conclusions: Racial disparities did not exist in patients undergoing elective surgery at a single VA Medical Center. Implementation of an ERP significantly reduced pLOS for black and white patients.

Keywords: Enhanced Recovery Pathways, Veterans Affairs, Disparities, Race

Background

In the United States, racial inequalities exist in the onset, course, outcome of illness, and in post-operative outcomes across surgical specialties [1–4]. Studies have shown that black patients experience longer post-operative lengths of stay (pLOS), more complications, and higher rates of mortality when compared with white patients [2, 5–8]. It remains unclear why these disparities exist and increased federal funding has been approved to understand these disparities as well as develop strategies to mitigate them [9].

One such strategy relies on the implementation of standardized protocols in the perioperative setting. Enhanced Recovery Pathways (ERP) are highly effective multimodal, evidence-based approaches intended...
to optimize surgical outcomes by reducing variations in
patient care. For example, ERP implementation has con-
sistently been shown to reduce post-operative complica-
tion rates without increasing cost or readmission rates [6,
10–13]. A growing body of literature supports the role
of ERP in reducing racial inequality in surgical care [14,
15]. Notably, ERP implementation was recently shown to
reduce racial disparities in post-operative length of stay
at a large academic medical center [16, 17]. Although
the mechanism by which ERP reduces racial inequality
is unknown, some hypotheses include: improved patient
education, mitigation of implicit or explicit bias, and bet-
ter adherence to evidence-based care practices, though
more studied are needed to understand the exact mecha-
nism [14].

The US Department of Veterans Affairs (VA) health-
care system provides surgical care to a racially diverse
population without the financial barriers that exist in
other healthcare settings [18]. It is unknown if racial dis-
parities exist following elective colorectal surgery in the
VA healthcare system. In addition, little is known about
ERP implementation within the Veterans Affairs Hos-
pital System and its effect on post-operative outcomes.
We hypothesized that racial disparities in pLOS exist
among patients at a single Veterans Affairs Hospital and
implementation of an ERP protocol would mitigate these
disparities.

Material and methods
In January 2016, an ERP protocol was implemented at the
Birmingham VA Medical Center. All patients undergoing
elective colorectal procedures were enrolled in the ERP
with no inclusion or exclusion criteria applied. A retro-
spective cohort study was conducted to assess differences
in post-operative outcomes between black and white
patients before and after the ERP protocol was imple-
mented at our institution. All patients that underwent an
operation using the ERP protocol between January 2016
and March 2018 were identified as ERP patients. Current
procedural terminology (CPT) Codes identified pre-ERP
patients that underwent similar operations from January
2010 to January 2016.

Demographic and procedural information was ret-
rospectively collected through the national, VA-wide
database Veterans Affairs Surgical Quality Improvement
Program (VASQIP) [19]. Patients who underwent emerg-
gent surgery or who had an in-hospital mortality were
excluded from the study. The primary outcome assessed
was post-operative length of stay (pLOS) stratified by
the two racial groups (black vs. white). Patients reported
their race on hospital intake forms and chart-abstrac-
tion was then used to assign patient race for the pur-
poses of this study. Non-black, non-white and patients
of unknown race were excluded from our analysis due to
low numbers (15 patients). Secondary outcomes include:
30-day VASQIP-assessed post-operative complications,
readmission rates, and ERP protocol adherence [19].
Included cases that were not assessed by VASQIP were
manually chart abstracted.

Procedures were classified into four categories, as
listed in Table 1. Abdominal Perineal Resection (APR),
Low Anterior Resection (LAR), Proctectomy, and Alte-
meier (Perineal Rectosigmoidectomy) were all classified
as “Rectal” procedures. Hemi-colectomy and Sigmoidec-
tomy procedures were classified as “Partial Colectomy”.
Ileostomy procedures were classified as “Small Bowel”
operations, and TAC/TPC refers to “Total Abdominal
Colectomy/Total Proctocolectomy”.

Prior to implementation of the ERP in 2016, perio-
perative management at the Birmingham VA Medi-
cal Center was not standardized. The ERP protocol was
implemented based on the ERAS Society Guidelines
for Colorectal Surgery and mirrors the ERP instituted
in our academic affiliate hospital, the University of Ala-
bama at Birmingham as published by Wahl et al. [16].
Patients undergoing elective colorectal procedures were
identified in clinic and subsequently educated on ERP.
Pre-operatively, patients were prescribed oral antibi-
otics and mechanical bowel prep when indicated and
were instructed to consume a carbohydrate-rich drink
the morning of surgery. Multi-modal pain management
was administered via oral acetaminophen, celecoxib, and
gabapentin in addition to intrathecal spinal analgesia.
Patients were assessed for risk of post-operative nausea
and vomiting and were treated prophylactically if indi-
cated. Post-operative pain management relied minimally
on opioids.

Pre-ERP and ERP patients were compared by patient
and procedure-specific characteristics, and by primary
and secondary outcomes. T-tests and Wilcoxon tests
were used to compare continuous variables, and Chi-
square tests were used for categorical variables. For
comparisons of categorical variables where the small-
est cell-count was ≤ 5, p-values were derived using 2000
Monte Carlo simulations [20]. Pre-ERP and ERP patients
were then stratified by race and compared in an identi-
cal method. A Fisher’s exact test was used to calcu-
late the power difference in rates between pre-ERP and
ERP patients. A two-sided test was used to calculate the
power difference in means.

There are 17 core-elements of the perioperative path-
way as defined by the ERAS Society (Table 2) includ-
ing patient education, minimally invasive surgical
techniques, and guidelines for post-operative mobiliza-
tion [6]. ERP adherence was calculated as the number
of components fulfilled divided by the total possible 17
components assessed based on the ERAS guideline recommendations [21]. Missing items (whether not done or undocumented) were counted as not adherent. Patients who received or adhered to 12 out of 17 components (70%), based on previously published literature [16] were considered ERP adherent. All analyses were performed using R Core Team (2019), with an alpha level of 0.05 considered statistically significant.

Results

Of 417 patients included (314 pre-ERP vs. 103 ERP), 35.0% were black. The average age of the cohort was 62.3 (SD 9.7) and 97.1% were male. No differences in demographic variables including sex, BMI, and age were observed between pre-ERP and ERP patients as shown in Table 1. Additionally, pre-ERP and ERP groups were similar in race, history of diabetes, and smoking status. The pre-ERP and ERP groups differed with regards to ASA class (p < 0.025) and procedure type (p < 0.001).

When stratified by race, black and white patients were similar in terms of sex, BMI, smoking status, rates of hypertension and diabetes across the pre-ERP and ERP groups. In the pre-ERP group, white patients were older than black patients (63.1 vs. 60.3 years (p = 0.02)) (Table 3). White patients in the pre-ERP group were

### Table 1  Patient and procedure characteristics

|                      | Overall (N = 417) | Pre-ERP (n = 314) | ERP (n = 103) | p   |
|----------------------|-------------------|-------------------|---------------|-----|
| **Patient level**    |                   |                   |               |     |
| Age, mean (SD)       | 62.32 (9.7)       | 62.11 (9.82)      | 62.96 (9.34)  | 0.440|
| BMI, mean (SD)       | 27.92 (5.5)       | 27.69 (5.34)      | 28.61 (5.83)  | 0.140|
| Sex                  |                   |                   |               |     |
| Female               | 12 (2.9)          | 6 (1.9)           | 6 (5.8)       | 0.080|
| Male                 | 404 (97.1)        | 308 (98.1)        | 96 (93.2)     |     |
| Smoker               | 175 (42.0)        | 140 (44.6)        | 35 (34.0)     | 0.076|
| Hypertension         | 194 (46.4)        | 66 (66.7)         | 66 (66.7)     | 0.767|
| Diabetes             | 95 (22.8)         | 71 (22.6)         | 24 (23.3)     | 0.524|
| ASA Class            |                   |                   |               |     |
| 1                    | 2 (0.2)           | 2 (0.6)           | 0 (0.0)       | 0.025|
| 2                    | 28 (6.7)          | 15 (4.8)          | 13 (12.6)     |     |
| 3                    | 360 (86.3)        | 274 (87.2)        | 86 (83.5)     |     |
| 4                    | 27 (6.5)          | 23 (7.3)          | 4 (3.9)       |     |
| **Operative level**  |                   |                   |               |     |
| Procedure            |                   |                   |               | 0.001|
| Partial colectomy    | 210 (52.1)        | 141 (46.5)        | 67 (69.8)     |     |
| Rectal               | 40 (9.9)          | 25 (8.3)          | 14 (14.6)     |     |
| Small Bowel          | 148 (36.7)        | 134 (44.2)        | 14 (14.6)     |     |
| TAC/TPC              | 5 (1.2)           | 3 (1.0)           | 1 (1.0)       |     |

All data represented as n (column %) unless otherwise specified

ASA Class, American Society of Anesthesiologist Class; BMI, body mass index; TAC/TPC, total abdominal colectomy/total proctocolectomy

*Overall* includes non-black, non-white patients and those whose race is unknown

### Table 2  Components of ERP adherence

|                      | Preoperative | Intraoperative | Postoperative |
|----------------------|--------------|----------------|---------------|
| Education            |              |                |               |
| Bowel Prep           |              |                |               |
| Fasting and carbohydrate treatment | | | |
| Preanesthetic medication | | | |
| Deep venous thrombosis (DVT) prophylaxis | | | |
| Antimicrobial prophylaxis | | | |
|                      |              |                |               |
|                      |              |                | Postoperative nausea and vomiting prophylaxis (PONV) |
|                      |              |                | Standardized anesthesia |
|                      |              |                | Minimally invasive approach |
|                      |              |                | Nasogastric intubation |
|                      |              |                | Hypothermia prevention |
|                      |              |                | Perioperative fluid management |
|                      |              |                |               |
|                      |              |                | Urinary drainage |
|                      |              |                | Prevention of postoperative ileus |
|                      |              |                | Postoperative analgesia |
|                      |              |                | Nutrition |
|                      |              |                | Early mobilization |

This table outlines the 17 components we considered in assessing ERP adherence. These components are based on the published ERAS guideline recommendations [20]
similar to white patients in the ERP group in all compared patient characteristics, but black patients had a slightly higher ASA class in the pre-ERP group when compared to the ERP group (Table 3).

### Primary outcome

Overall, ERP patients had a significantly shorter pLOS (median 4 [interquartile range (IQR) 3–6.5] vs 6 [IQR 4–9] days; p < 0.001) when compared with pre-ERP patients. Within the pre-ERP group, median pLOS for both black and white patients was 6 days (IQR: 4–6; p = 0.98). Both groups experienced a decrease in median pLOS (4 vs 6, p < 0.009 and p < 0.001, respectively) following ERP implementation. Additionally, no significant difference in pLOS between black and white patients following ERP implementation was observed (p = 0.61) (Table 4).

### Secondary outcomes

Following implementation of ERP, patients experienced reduced pLOS without increased 30-day readmission (16.5% vs 11.8%, p = 0.28). Additionally, there was no significant increase in VASQIP assessed post-operative complications following ERP implementation (22% vs. 25.2%, p = 0.58). Within the pre-ERP cohort, white patients experienced higher rates of 30-day readmission

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**Table 3** Race-stratified patient and procedure characteristics

|                  | Pre-ERP Overall (N = 314) | Black (n = 110) | White (n = 193) | p       | ERP Overall (N = 103) | Black (n = 36) | White (n = 63) | p       |
|------------------|---------------------------|----------------|----------------|--------|-----------------------|----------------|----------------|--------|
| Age, mean (SD)   | 62.11 (9.82)              | 60.27 (9.25)   | 63.09 (10.2)   | 0.017  | 62.96 (9.34)          | 61.83 (8.72)   | 64.14 (9.45)   | 0.232  |
| BMI, mean (SD)   | 27.69 (5.34)              | 27.05 (5.08)   | 28.09 (5.49)   | 0.104  | 28.61 (5.83)          | 29.53 (7.11)   | 27.95 (4.95)   | 0.196  |
| Sex              |                           |                |                |        |                       |                |                |        |
| Male             | 308 (98.1)                | 107 (97.3)     | 190 (98.4)     | 0.689  | 96 (93.2)             | 33 (91.7)      | 60 (95.2)      | 0.361  |
| Smoker           | 140 (44.6)                | 51 (46.4)      | 83 (43.0)      | 0.656  | 35 (34.0)             | 11 (30.6)      | 23 (36.5)      | 0.670  |
| Hypertension     | 194 (64.4)                | 78 (40.0)      | 117 (60.0)     | 0.094  | 66 (66.7)             | 26 (39.4)      | 40 (60.6)      | 0.528  |
| Diabetes         | 71 (22.6)                 | 27 (24.5)      | 42 (21.8)      | 0.847  | 24 (23.3)             | 11 (30.6)      | 12 (19.0)      | 0.430  |
| ASA class        |                           |                |                |        |                       |                |                |        |
| 1                | 2 (0.6)                   | 1 (0.9)        | 1 (0.5)        | 0.000  |                      |                |                | 0.000  |
| 2                | 15 (4.8)                  | 2 (1.8)        | 13 (6.7)       | 0.000  |                      |                |                | 0.000  |
| 3                | 274 (87.2)                | 101 (91.8)     | 165 (85.5)     | 0.847  | 86 (83.5)             | 31 (86.1)      | 53 (84.1)      | 0.430  |
| 4                | 23 (7.3)                  | 6 (5.5)        | 14 (7.3)       | 0.847  | 4 (3.9)               | 0 (0.0)        | 4 (6.3)        |       |
| Operative level  |                           |                |                |        |                       |                |                |        |
| Procedure        |                           |                |                |        |                       |                |                |        |
| Partial colectomy| 141 (46.5)                | 51 (36.2)      | 90 (63.8)      | 0.242  | 67 (69.8)             | 25 (37.3)      | 42 (62.7)      | 0.895  |
| Rectal           | 25 (8.3)                  | 8 (32.0)       | 17 (68.0)      | 0.242  | 14 (14.6)             | 5 (35.7)       | 9 (64.3)       | 0.242  |
| Small Bowel      | 134 (44.2)                | 49 (36.6)      | 85 (63.4)      | 0.242  | 14 (14.6)             | 4 (28.6)       | 10 (71.4)      | 0.242  |
| TAC/TPC          | 3 (1.0)                   | 2 (66.7)       | 1 (33.3)       | 0.242  | 1 (1.0)               | 0 (0.0)        | 1 (100.0)      | 0.242  |

All data represented as n (column %) unless otherwise specified

ASA Class, American Society of Anesthesiologist Class; BMI, body mass index; TAC/TPC, total abdominal colectomy/total proctocolectomy

“Overall” includes non-black, non-white patients and those whose race is unknown

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**Table 4** Post-operative length of stay pre and post-ERP

|                  | Pre-ERP Overall (N = 314) | Black (n = 110) | White (n = 193) | p       | ERP Overall (N = 103) | Black (n = 36) | White (n = 63) | p       | Overall p |
|------------------|---------------------------|----------------|----------------|--------|-----------------------|----------------|----------------|--------|-----------|
| Median, IQR      | 6 (4.0–9.0)               | 6 (4.0–9.0)    | 6 (4.0–9.0)    | 0.976  | 4 (3.0–6.5)           | 4 (3.0–8.5)    | 4 (2.5–6.0)    | 0.6122 | 0.001     |
| Mean, SD         | 8.4 (8.4)                 | 8.5 (8.2)      | 8.0 (7.3)      | 0.607  | 5.8 (5.3)             | 6.7 (6.2)      | 5.1 (4.4)      | 0.1382 | 0.003     |

All data represented as n (column %) unless otherwise specified

“Overall” includes non-black, non-white patients and those whose race is unknown

IQR, interquartile range; SD, standard deviation
than black patients (15.0% vs. 6.4%, p = 0.04), but following ERP implementation that difference was mitigated (13.9% vs. 19.0%, p = 0.58). There were no significant differences in any 30-day complications when patients were stratified by race within each cohort (Table 5). Overall, racial disparities were not observed following the ERP intervention with black and white patients being similar in all outcomes assessed (Table 5).

**Protocol adherence**
Overall, 87.5% of ERP patients (86) received or adhered to at least 12 of the 17 components for an average ERP adherence rate of 81.4%. There was no significant difference in overall adherence between black and white patients (82.3% vs 80.9%; p = 0.56) and there were no significant differences in adherence between races in any of the 17 intervention components (results not shown). Preoperative education, deep venous thrombosis (DVT) prophylaxis and antimicrobial prophylaxis interventions were achieved in every patient. Additionally, every patient was maintained at normal intraoperative body temperatures (> 36.8 °C). Multimodal analgesia administration guidelines were followed in over 97% of ERP patients. Early regular diet was initiated more than 89% of the time. Compliance with urinary catheter removal by POD 1 reached 77.3% and while not an ERP guideline, only 15 patients (15.6%) required urinary catheter reinsertion due to retention or resuscitation. 57.3% of patients achieved the guidelines for perioperative fluid management, and early mobilization at POD 1 was achieved in 37.9% of patients (Additional file 1: Table S1).

### Table 5 30-day secondary outcome assessment

|                | Pre-ERP (N = 314) | ERP (N = 103) | p      | Overall p |
|----------------|-------------------|---------------|--------|-----------|
| Readmission    | 37 (11.8)         | 17 (16.5)     | 0.040  | 0.580     |
| Any complication | 69 (22.0)        | 26 (25.2)     | 0.271  | 0.443     |
| 1 complication | 49 (15.6)         | 14 (13.6)     | 0.040  | 0.280     |
| 2 complication | 13 (4.1)          | 6 (5.8)       | 0.271  | 0.580     |
| 3 complication | 4 (1.3)           | 5 (4.9)       | 0.271  | 0.580     |
| 4 complication | 2 (0.6)           | 2 (1.9)       | 0.271  | 0.580     |
| 5 complication | 1 (0.3)           | 1 (0.5)       | 0.271  | 0.580     |
| SSI            |                   |               |        |           |
| Superficial    | 25 (8.0)          | 8 (7.8)       | 0.925  | 1.000     |
| Deep           | 0 (0.0)           | 0 (0.0)       | –      | –         |
| Open wound infection | 16 (5.1) | 7 (6.8)       | 0.925  | 1.000     |
| Pneumonia      | 10 (3.2)          | 3 (2.9)       | 0.925  | 1.000     |
| Intubation     | 7 (2.2)           | 2 (1.9)       | 0.925  | 1.000     |
| PTE            | 0 (0.0)           | 1 (1.0)       | 0.925  | 1.000     |
| Renal insufficiency | 3 (1.0) | 3 (2.9)       | 0.925  | 1.000     |
| Renal failure  | 1 (0.3)           | 1 (0.5)       | –      | –         |
| UTI            | 17 (5.4)          | 7 (6.8)       | 0.925  | 1.000     |
| MI             | 0 (0.0)           | 0 (0.0)       | –      | –         |
| Bleeding       | 0 (0.0)           | 0 (0.0)       | –      | –         |
| DVT            | 4 (1.3)           | 4 (3.9)       | 0.925  | 1.000     |
| Sepsis         | 7 (2.2)           | 5 (2.6)       | 0.925  | 1.000     |
| Return to OR   | 20 (6.4)          | 8 (7.8)       | 0.925  | 1.000     |
| Cardiac arrest | 0 (0.0)           | 0 (0.0)       | –      | –         |
| CVA            | 0 (0.0)           | 0 (0.0)       | –      | –         |

All data represented as n (column %) unless otherwise specified

*Overall* includes non-black, non-white patients and those whose race is unknown

CVA, cerebrovascular accident; DVT, deep vein thrombosis; MI, myocardial infarction; OR, operating room; PTE, pulmonary thromboembolism; SSI, surgical site infection; UTI, urinary tract infection
Power
Based on prospective power calculations, for comparing the pre-ERP vs. the ERP group using two-sided t-tests and Chi-square tests with alpha < 0.05 our sample provided 80% power to detect a difference in means of 0.32 standard deviations and a difference in rates of 15% vs. 5% or 25% vs. 12%. When comparing black and white patients within the pre-ERP cohort, there is 80% power for a difference in means of 0.36 standard deviations; for comparing black and white patients within the ERP group, there was 80% power for a difference in means of 0.59 standard deviations and rates of 15% vs. 1% and 25% vs. 5%.

Discussion
Little research has been done to assess the effect of ERP implementation within the Veterans Affairs healthcare system. In our study, we identified that ERP implementation significantly reduced pLOS for patients undergoing elective colorectal surgery. The reduction in pLOS after ERP implementation was achieved without significant increases in post-operative readmission rate or major post-operative complications. ERP patients in our study experienced an overall decreased median pLOS by 2 days, which is similar to reports of ERP effectiveness at other institutions [16, 22, 23]. In terms of secondary outcomes following ERP implementation, our complication rates are similar to those found in other studies. The rate of having any complication was 25% in our study, comparable to other reports of 22.4% [16] and 31.8% [11] and our readmission rate post-ERP implementation (16.5%) was also similar to other reports (17.6%) [16]. Higher levels of ERP adherence have been shown to improve post-operative outcomes in a dose-dependent relationship [10]. In our study, 87.5% of patients adhered to 12 or more of the 17 ERP protocol guidelines and black and white patients had similar rates of ERP compliance (85.5% vs. 88.5%, p = 0.74).

Based on findings from a similar study conducted by Wahl et al. at The University of Alabama Birmingham (UAB), a large academic medical center and our academic affiliate partner, we expected a racial disparity in pLOS to exist between black and white patients prior to ERP implementation [16]. We did find that our patient populations were racially similar (28% black vs. 35% black), however, the pre-operative lengths of stay at UAB varied by race: (black patients had an average pLOS of 10.07 days, white patients average pLOS of 7.13 days (p = 0.03) [16]) while they did not in our patients: (average 8.4 days between black patients and white patients (p = 0.67)).

Studies investigating racial disparities within the VA healthcare system are limited, though several have demonstrated significant racial disparity in clinical outcomes despite provision of medical care free-of-charge to those who qualify [24, 25]. A systemic review of racial disparities in the VA system found that while differences in outcomes exist in all clinical arenas, disparities are more frequently observed for processes associated with higher risk or which require more significant decision making by patients and/or providers (i.e. surgery/invasive procedures). Factors likely contributing to these findings include differences in health literacy, patient participation, and social support between black and white veterans [26]. While there are some studies that have shown that racial disparities within the VA Hospital System are not as apparent as in other hospital systems, our hypothesis was generated based on the findings we observed at our academic affiliate hospital [27, 28]. While we did not quantify it, our patients live in the same state, were treated under the same pathway and by the same surgeons and resident teams. Contrary to findings in non-VA settings [16], we found that racial disparities did not exist in patients undergoing colorectal surgery in the Birmingham VA Medical Center, though further study is needed to assess underlying factors contributing to this finding. We hope that this will stimulate future research efforts aimed at identifying the processes of care unique to the VA driving this finding.

While ERP has been shown to improve post-surgical outcomes in various hospital settings, little is known of the effects of ERP implementation within the Veterans Affairs healthcare system. Implementation of the ERP significantly reduced pLOS for both black and white patients in the VA hospital system without increasing complications, suggesting that interventions that improve the consistency of care by standardizing protocols may reduce variations in observed outcomes based on race. Lau and colleagues demonstrated this concept in addressing racial disparities in venous thromboembolism prophylaxis on a trauma service in which black and white patients received standard care 56.6% and 70.1% of the time, respectively [29]. Following standardization of venous thromboembolism prophylaxis choices, racial disparities were eliminated [29]. Like ERP, this pathway followed evidence-based algorithms to guide physicians in clinical management demonstrating that when care was applied to all patients in the same manner, the results were the same for all patients [14]. Other proposed mechanisms by which ERP programs improve outcomes for all patients include increased patient education, systematic implementation of best practices in the perioperative setting, mitigation of implicit or explicit bias, and increased adherence to evidence-based care practices [14].

Based on these findings, future work should include expanding the cases performed under ERP at our
institution as well as encouraging other Veteran's Affairs hospital to adopt ERP for their patients.

There are certain limitations of this study that are worth noting, and, as with any retrospective analysis, its findings must be interpreted within the context of the data. First, because healthcare documentation is variable amongst providers, it was difficult to acquire complete data to assess protocol adherence, although our compliance rates are high and any missing information was assumed to be nonadherent, therefore biasing our statistical decision towards the null. While our sample sizes do reflect several years-worth of elective colorectal procedures at our institution, the sample size of black patients in our intervention group (ERP) is modest (36 patients) therefore reducing the statistical power of our study. Additionally, our ERP cohort is considerably smaller than our pre-ERP cohort (103 vs. 314). Another limitation of our study is that we analyzed patient race in an isolated manner without taking into consideration other patient factors, like socioeconomic status, rurality, patient education level, or marital status, for example, that are likely also contributing to our study findings. We need to further understand and separate specific patient sociodemographic factors to understand which ones are related to surgical outcomes and which ones we can intervene upon. Lastly, our pre-ERP cohort includes patients who underwent procedures between 2010 and 2016 whereas our ERP cohort only captures patients since ERP implementation (2016–2018). The longer time period for pre-ERP inclusion may have inadvertently introduced some temporal effects.

Despite the stated limitations, our study has notable strengths compared to other studies on ERP implementation. First, we had already successfully established an ERP at a large academic medical center (our academic affiliate) in the same city. This helped decrease variation in our protocol and established guidelines for implementation in our hospital system. As a result, we modeled our study design on the ERP implementation study at that institution to help guide our assessment of outcomes. Lastly, while ERP implementation has been assessed in academic and community hospitals, evaluation within our protocol and established guidelines for implementation (2016–2018). The longer time period for pre-ERP inclusion may have inadvertently introduced some temporal effects.

Conclusion
In our study, we found that there were no racial disparities in pLOS among black and white patients at our institution, and that ERP implementation significantly decreased pLOS. ERP targets the whole continuum of perioperative care and therefore can be employed to achieve health equity for surgical patients across healthcare settings and should be widely adopted.

Supplementary Information
The online version contains supplementary material available at https://doi.org/10.1186/s12893-022-01647-3.

Additional file 1: Table S1. ERP Adherence Rates.

Acknowledgements
We would like to thank the multidisciplinary Birmingham Veterans Affairs Hospital ERP team for their continued support and implementation of our ERP protocol.

Author contributions
CR assisted with data collection and was a major contributor in writing the manuscript. SB was a major contributor in writing the manuscript and was involved in project conception. LG assisted with data collection, analysis and assisted in writing the manuscript. JR performed the data analysis and interpretation. SK was involved in project conception and ERP implementation. CK was involved in ERP implementation and was involved with project conception. MM performed the surgeries, was involved in ERP implementation at our institution and was involved in the conception of this project, writing and revising this manuscript. All authors read and approved the final manuscript.

Funding
Funding was obtained from the VA Medical Center.

Availability of data
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This research project was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board at The University of Alabama School of Medicine and the Birmingham VA Medical Center. IRB Study ID is 01663. Informed consent for research participation was obtained from patients.

Consent for publication
Not applicable.

Competing interests
There are no competing interests to disclose.

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Received: 17 January 2021 Accepted: 9 May 2022
Published online: 21 May 2022

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