Obstetrics and Gynecology

Original Article

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Implementation of an enhanced recovery after surgery (ERAS) protocol for total abdominal hysterectomies in the division of gynecologic oncology: a network-wide quality improvement initiative

https://doi.org/10.1515/jom-2022-0204
Received October 2, 2022; accepted May 23, 2023; published online June 16, 2023

Abstract

Context: Enhanced Recovery After Surgery (ERAS) protocols have been shown to decrease length of stay and postoperative opioid usage in colorectal and bariatric surgeries performed at large academic centers. Hysterectomies are the second most common surgical procedure among women in the United States. Hysterectomies performed in an open fashion, or total abdominal hysterectomies (TAHs), account for a large portion of procedures performed by gynecologic oncologists secondary to current oncology guidelines and surgical complexity. Implementation of an ERAS protocol for gynecologic oncology TAHs is one way in which patient outcomes may be improved.

Objectives: An ERAS protocol for gynecologic oncology surgeries performed in a community hospital was instituted with the goal to optimize patient outcomes preoperatively. The primary outcome of interest was to reduce patient opioid usage. Secondary outcomes included compliance with the ERAS protocol, length of stay, and cost. Thirdly, this study aimed to demonstrate the unique challenges of implementing a large-scale protocol across a community network.

Methods: An ERAS protocol was implemented in 2018, with multidisciplinary input from the Departments of Gynecologic Oncology, Anesthesia, Pharmacy, Nursing, Information Technology, and Quality Improvement to develop a comprehensive ERAS order set. This was implemented across a 12-site hospital system network that consisted of both urban and rural hospital settings. A retrospective review of patient charts was performed to assess measured outcomes. Parametric and nonparametric tests were utilized for statistical analysis with $p<0.05$ denoting statistical significance. If the p value was >0.05 and <0.09, this was considered a trend toward significant.

Results: A total of 124 patients underwent a TAH utilizing the ERAS protocol during 2018 and 2019. The control arm consisted of 59 patients who underwent a TAH prior to the ERAS protocol intervention, which was the standard of care in 2017. After 2 years of implementation of the ERAS protocol intervention, we found that 48 % of the ERAS patients had minimal opioid requirements after surgery (oral morphine equivalent [OME] range 0–40) with decreased postoperative opioid requirements in the ERAS group (p=0.03). Although not statistically significant, utilization of the ERAS protocol for gynecologic oncology TAHs trended toward shorter hospital length of stay from 5.18 to 4.17 days (p=0.07). The median total hospital costs per patient also showed a nonsignificant decrease in cost from $13,342.00 in the non-ERAS cohort and $13,703.00 in the ERAS cohort (p=0.8).

Conclusions: A large-scale quality improvement (QI) initiative is feasible utilizing a multidisciplinary team to implement an ERAS protocol for TAHs in the division of Gynecologic Oncology with promising results. This large-scale QI result was

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comparable to studies that conducted quality-improvement ERAS initiatives at single academic institutions and should be considered within community networks.

Keywords: gynecology; pain management; surgery.

Enhanced Recovery After Surgery (ERAS) protocols were first developed by colorectal surgeons in the early 1990s to provide a systematic structure for managing postsurgical patients. ERAS protocols are a multimodal perioperative care pathway designed to achieve early postsurgical recovery for patients undergoing major surgery [1]. These protocols promote evidenced-based practices and implement a multidisciplinary effort to maintain normal physiology in the perioperative period and aid in earlier recovery [2]. Common measures shared across the majority of ERAS protocols are listed in Figure 1. ERAS now plays an important role in colorectal, ENT (ear, nose, and throat), liver/pancreas, vascular, and thoracic surgery. In 2018, The American College of Obstetricians and Gynecologists (ACOG) proposed an ERAS protocol for gynecologic procedures. Hysterectomies are the second most common surgery performed on women in the United States, with caesarean sections being the first [3]. Therefore, creating ERAS protocols for gynecologic surgery is instrumental in reducing length of stay, decreasing costs, and reducing the likelihood of hospital readmissions [1, 4].

With the advance of technology, many hysterectomies in the United States are performed utilizing a minimally invasive approach to reduce morbidity and postoperative pain. Vaginal, laparoscopic, and robotic approaches are associated with decreased blood loss and shorter length of stay in comparison to an abdominal hysterectomy (TAH) [3, 5]. However, there are still several indications that favor an open procedure, including early-stage cervical cancer with lympho-vascular invasion along with the bulky nature of many gynecologic cancers that preclude a minimally invasive approach. In the United States, upwards of 28 % of hysterectomies are still performed through an abdominal approach, particularly within the field of gynecologic oncology [2, 6].

Many of the advances in gynecologic oncology originate from single-site academic universities and tend to be implemented later in community settings. Literature supports the implementation of ERAS protocols and shows significant advantages in postoperative recovery following hysterectomies conducted in community hospital settings [6, 7]. By instituting an ERAS protocol within the Division of Gynecologic Oncology as a quality improvement (QI) project in a community hospital setting, more generalizable expectations about the success of ERAS protocols can be drawn, given that approximately 84 % of US hospitals are community-based [7, 8]. The aim of our initiative was to reduce postoperative opioid consumption, length of stay, and cost. Unlike previously published literature, our QI initiative was centered around an entire community-based hospital network that includes hospitals in both rural and urban settings, serving a diverse patient population. We hope to demonstrate that previously reported quality standards of care are feasible to implement in the community setting with similar outcomes and quality measures that were shown at academic institutions.

Methods

Our QI project was considered exempt through the St. Luke's University Health Network's Institutional Review Board (Local ID SLIR 2021-73). The Departments of Gynecologic Oncology and Anesthesia developed a

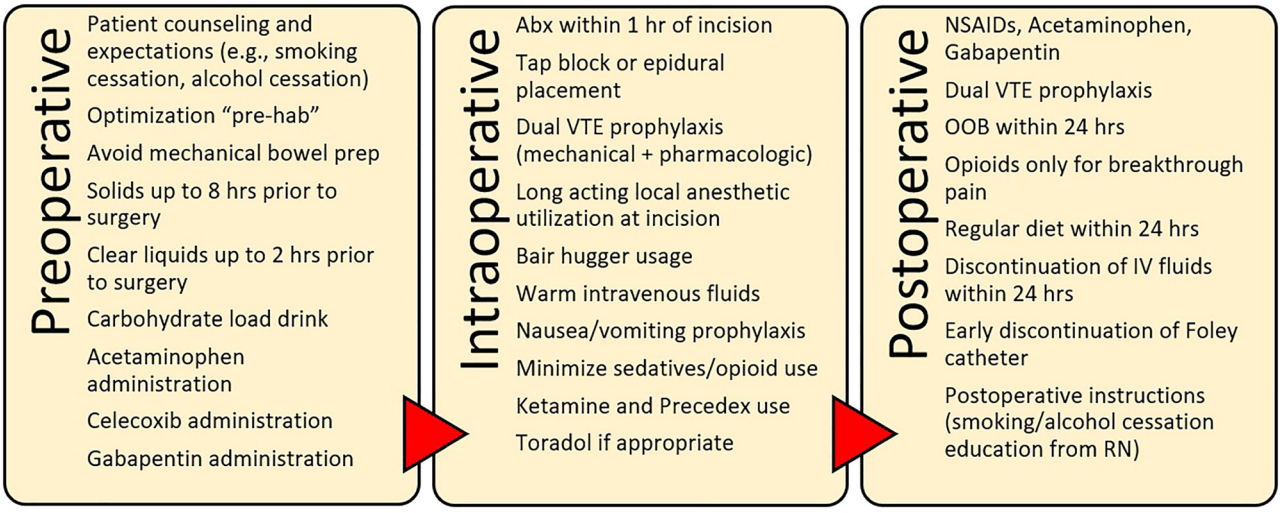

Figure 1: The ERAS protocol designed forTAHs. ABX, antibiotics; ERAS, Enhanced Recovery After Surgery; hr, hour; hrs, hours; NSAIDs, nonsteroidal anti-inflammatory drugs; OOB, out of bed; RN, registered nurse; TAH, total abdominal hysterectomy; VTE, venous thromboembolism.

network-specific ERAS protocol derived from previously reported literature (Figure 1). The protocol focused on measures that would benefit the patient during the pre-, intra-, and postoperative periods. The first component of the QI initiative consisted of interdisciplinary meetings to discuss the implementation of the ERAS protocol with preoperative nurses, postanesthesia care unit (PACU) nurses, and floor nurses. Standardization of the ERAS protocol was achieved through creation of an order set within the electronic medical record (EMR) system. The order set was built with input from the Departments of Pharmacy, Information Technology (IT), and the QI committee within the gynecologic oncology department. An opioid conversion scale was utilized to convert intravenous and oral opioid medications into OMEs (Figure 2). A chart review was performed to assess compliance with the ERAS protocol.

The primary outcome of interest was postoperative opioid consumption. OMEs were utilized as the measure for which the pre- and postopioid consumption analysis was conducted. Secondary outcomes of interest included the ERAS protocol compliance, length of stay, and cost. Patient data were collected retrospectively. All patients who underwent a total abdominal hysterectomy (TAH) from 2017 to 2019 by a gynecologic oncologist (IZ, NT, RB, SP, AG) in our hospital network were included. The same clinical team cared for the patients in both the pre- and post-ERAS groups. Statistical analysis was performed utilizing SPSS version 26 (IBM Corp, Armonk, NY). Unadjusted comparisons between treatment groups utilizing chi-square tests or Fisher's exact tests were utilized, as appropriate. Mann Whitney U tests were utilized to assess length of stay, postoperative opioid requirements, and total cost variables between groups. For all comparisons, $p<0.05$ denoted statistical significance, with no adjustment for multiple testing. If the p value was >0.05 and <0.09, this was considered a trend toward significant.

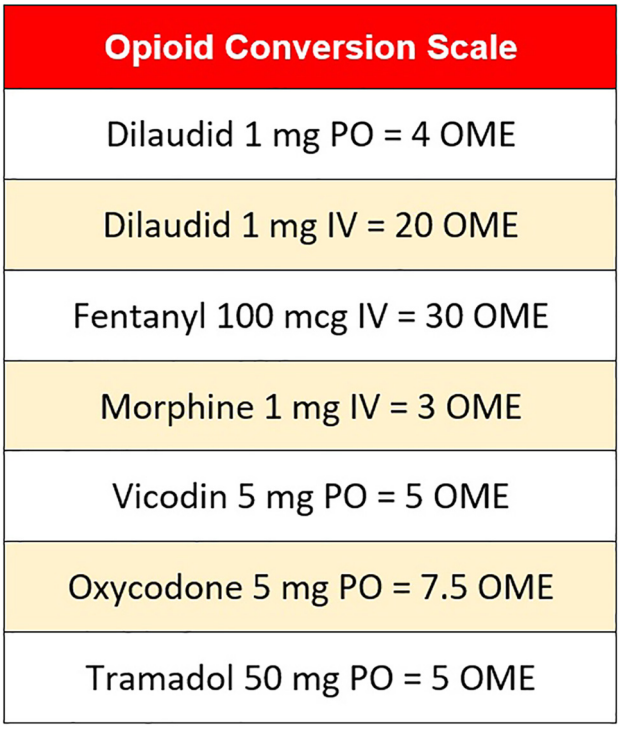

Figure 2: Opioid conversion chart utilized in our ERAS protocol for TAHs within the Division of Gynecologic Oncology. ERAS, Enhanced Recovery After Surgery; IV, intravenous administration; mcg, micrograms; mg, milligrams; OME, oral morphine equivalent; PO, oral administration; TAH, total abdominal hysterectomy.

Results

After conducting our QI initiative, a total of 183 patients were included in the final analysis, with 59 in the non-ERAS cohort and 124 in the ERAS cohort. The non-ERAS cohort consisted of patients who had a TAH performed in 2017, whereas the patients who underwent a TAH during 2018 or 2019 were considered part of the ERAS cohort after implementation. Demographically, the mean age of ERAS patient was 59 (37–84) years old, whereas the mean age of the non-ERAS patients was 57.9 (26–83) years old. Among the ERAS patients, 83.1 % are white and 54.8 % are married, compared to 86.4 and 50.4 %, respectively, of non-ERAS patients (Table 1). Of note, the participants in the study were classified into their racial categories by the predetermined options on hospital admission. They were self-identified and not designated by the research team. We recognize that racial and ethnic distinctions are not considered absolute, and this is a limitation of our study.

The median OME consumption among the non-ERAS cohort was 56 OMEs (range, 8–137) compared to 40 OMEs (range, 0–129) among the ERAS cohort. This was statistically significant (p=0.03). Figure 3 stratifies the changes in opioid consumption based upon the OME of the opioids consumed.

Table 1: Basic demographics of the ERAS vs. non-ERAS cohorts.

Group	Race	Ethnicity	Social status
ERAS (n=124) Median age: 59	White (83.1 %) Black (8.1 %) Asian (0.8 %) American Indian (0.8 %) Declined to answer (7.3 %)	Non-Hispanic (92.7 %) Hispanic (6.5 %) Declined to answer (0.8 %)	Married (54.8 %) Divorced (10.5 %) Single (21.8 %) Widowed (11.3 %) Significant other (0.8 %) Legally separated (0.8 %)
Non-ERAS (n=59) Median age: 57	White (86.4 %) Black (5.1 %) Asian (5.1 %) American Indian (0 %) Declined to answer (3.4 %)	White (89.8 %) Hispanic (8.5 %) Declined to answer (1.7 %)	Married (50.8 %) Divorced (16.9 %) Single (22 %) Widowed (10.2 %) Significant other (0 %) Legally separated (0 %)
p-Value[a]	N/A	N/A	0.78

[a]Based on chi-square tests, as appropriate, and based on sufficient subgroup samples. ERAS, Enhanced Recovery After Surgery.

Prior to implementing the ERAS protocol, there was an equal distribution in the proportion of patients receiving 0 to 40 OMEs (34 %), 41 to 60 OMEs (15 %), 61 to 90 OMEs

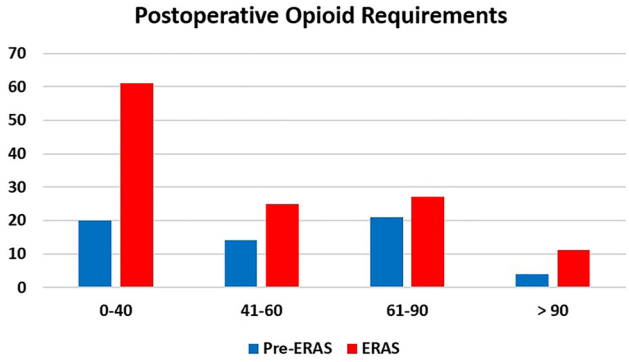

Figure 3: OME requirements during the postoperative period for the non-ERAS and ERAS cohorts. 0–40=minimum opioid usage; 41–60=moderate opioid usage; 61–90=severe opioid usage; >90=excessive opioid usage. ERAS, Enhanced Recovery After Surgery; OME, oral morphine equivalent.

(34 %), or >90 OMEs (17 %) postoperatively. In comparison, the majority of patients received less than 60 OMEs after ERAS protocol implementation (69 %).

The median length of stay decreased from 5.18 days (range 2–21 days) to 4.17 days (range 1–16 days) after ERAS implementation. Although this measure was not statistically significant (p=0.07), there is a shorter trend for the ERAS group. No statistically significant difference in cost was noted between the groups, with a median cost of $13,342.00 in the non-ERAS cohort and $13,703.00 in the ERAS cohort (p=0.8).

Of the 19 endpoints that assessed ERAS protocol compliance, eight showed statistically significant differences between the two cohorts (Table 2). Two categories could not be analyzed secondary to insufficient data. There was a significant increase in preoperative carb drink (0–82, p<0.0001), preoperative nonnarcotic pain medication utilization (5–55, p<0.0001), usage of surgical site infection (SSI) measures (35–113, p<0.001), preoperative deep vein thrombosis (DVT) prophylaxis (59–114, p=0.03), epidural or tap block utilization (29–104, p<0.001), proportion of patients receiving postoperative Tylenol (acetaminophen, 36 to 122, p<0.001), intravenous fluids (IVFs) stopped on postoperative day 1 (12–52, p=0.01), and diet advanced by postoperative day 1 (38–112, p<0.001). A compliance rate of >90 % was seen in 7 of the 19 endpoints.

Table 2: Statistical analysis of ERAS protocol outcomes for the ERAS and non-ERAS cohorts.

Parameter of interest	ERAS cohort (n=124)	Non-ERAS cohort (n=59)	p-Value
Discharge to home	Yes: 95 (76.6 %) No: 8 (6.5 %)	Yes: 40 (67.8 %) No: 4 (6.8 %)	N/A[a]
Preoperative carb drink	82 (66.1 %)	0	<0.0001
Preoperative pain meds	55 (44.4 %)	5 (8.5 %)	<0.0001
SSI measures ordered	113 (91.1 %)	35 (59.3 %)	<0.0001
Preoperative DVT prophylaxis	114 (91.9 %)	59 (100 %)	0.03
Intraoperative PONV meds	123 (99.2 %)	58 (98.3 %)	N/A[b]
Intraoperative ketamine or precedex (dexmedetomidine) use	42 (33.9 %)	18 (30.5 %)	0.65
Intraoperative antibiotic use	124 (100 %)	59 (100 %)	N/A
Epidural or tap block	104 (83.9 %)	29 (49.2 %)	<0.0001
If DM, glucose<200 postoperatively	16/24 (66.7 %)	9/14 (64.3 %)	0.78
Postoperative tylenol (acetaminophen)	122 (98.4 %)	36 (61 %)	<0.0001
Postoperative NSAIDs	90 (72.6 %)	40 (67.8 %)	0.51
Postoperative nausea	33 (26.6 %)	12 (20.3 %)	0.36
Postoperative ileus	19 (15.3 %)	6 (10.2 %)	0.34
Postoperative urinary retention	5 (4 %)	0	N/A[c]
Postoperative DVT prophylaxis	123 (99.2 %)	59 (100 %)	N/A[b]
OOB ambulating by POD 1	36 (29 %)	17 (28.8 %)	0.62
IVF stopped by POD 1	53 (42.7 %)	12 (20.3 %)	0.01
Diet advanced by POD 1	112 (90.3 %)	38 (64.4 %)	<0.0001

DM, diabetes mellitus; DVT, deep vein thrombosis; ERAS, Enhanced Recovery After Surgery; IVF, intravenous fluids; NSAIDs, non-steroidal anti-inflammatory drugs; OOB, out of bed; POD, postoperative day; PONV, postoperative nausea and vomiting; SSI, surgical site infection; TAP, transversus abdominus plane. [a]Too few responses for certain subcategories. [b]Response distribution is essentially equal. [c]Too few responses for a meaningful comparison.

Discussion

ERAS protocols for TAHs within the Gynecologic Oncology division have previously been shown to be highly efficacious in reducing length of stay, postoperative opioid consumption, and overall cost in single-center academic and community hospital settings. Nelson et al. [9] demonstrated that early feeding, maintaining euvolemic status, and providing multimodal analgesia have decreased the rate of ileus in women with complex open gynecologic cancer surgeries. Jimenez et al. [7] implemented an ERAS protocol at a large, intercity community hospital and utilized gabapentin and multimodal analgesia to reduce postoperative opioid usage. Results demonstrated significant reduction in opioid usage with a mild elevation in postoperative pain scores and no change in length of stay [7]. Mendivil et al. [4] conducted a similar initiative, but unlike the insignificant difference in hospital stay seen in the initiative conducted by Jimenez et al. [7], they were able to demonstrate a 3-day mean reduction in hospital length of stay with an approximately $2,500 per patient reduction in cost and a reduction in readmission rates by 2 % [4]. Our work differs from the previously mentioned studies in that an ERAS protocol was implemented for gynecologic oncology TAHs within our community-based, multi-hospital network that consisted of both urban and rural settings. Our results were as successful as

previously published studies regarding reducing postoperative usage of opioid medications from 48 to 34 %. Unfortunately, we were unable to demonstrate significant change among length of stay or cost. The most significant contribution that our work provides is that an ERAS protocol can be created and standardized through a large community-based hospital network. This was shown in our work, with an overall high compliance rate of >90 % compliance in 7 of the 19 endpoints. Overall, this lends to the ability to implement higher standards of care within a large network of community-based hospitals, an aspect in healthcare improvement that has not been robustly depicted in the previous literature.

One aspect of our success in initiating this protocol can be attributed to the multidisciplinary team approach, which consisted of contributions from Pharmacy, IT, QI, the Department of Gynecology, and the Department of Anesthesia. It has been shown that the simple practice of involving others in the design and implementation of a QI initiative can improve adherence to clinical practice guidelines. Jun et al. [10] utilized this concept to demonstrate that nurses were more willing to following clinical practice guidelines when they were included in the implementation of such guidelines. The collaboration in the design and build of the order set led to each respective department taking a personal level of ownership in the project, which can therefore increase compliance rates. Along with incorporating a multidisciplinary approach, another potential strength of our study involved the use of an EMR to partially automate the QI initiative. Electronic order sets have been shown to be a significant driver of clinician decision making. By changing the default setting from “optional” to “preselected,” Olson et al. [11] was able to significantly increase the rate of posttransfusion platelet counts ordered from 7 % of platelet transfusions to 59.4 % ($p<0.0001$). Another example seen was a computer-based algorithm in an EMR that provided a sepsis-specific workup and resuscitation plan for patients at risk of sepsis in the emergency department; it was capable of increasing bundle compliance by 154 %, increasing compliance from 28 to 71 % [12]. Change should continue to be driven through EMR order sets to make adherence to new protocols as easy as possible.

Even in the presence of several important strengths, several limitations of our study must be acknowledged. The first major limitation includes the small sample size. Increasing the sample size by including data from previous years, as well as including further data points from postimplementation, may have revealed more significant secondary outcomes. Our study was only conducted the year following implementation and may have failed to capture statistical trends as compliance rates further increased. Another limitation is the unplanned nature of some TAHs. Conversion from a minimally invasive surgery (MIS) approach to TAH usually involves radical surgical intervention from complication or cancer extent. These patients would likely require a longer length of stay and require higher opioids secondary to longer operative times and more extensive dissection, and thus may have skewed the data.

One future direction could be to stratify the unplanned TAH cohort in order to establish the effect a conversion from an MIS approach to a TAH that may play on the same endpoints. Another future direction could include a more targeted approach to further reduce length of stay, which could subsequently reduce overall cost [13]. Lastly, more in-depth multidisciplinary approaches could increase compliance and secondary endpoints further, such as utilizing physical therapy services to help improve postoperative ambulation. After demonstrating the success of the ERAS protocol for TAHs done within the Gynecologic Oncology division, we aim to implement the protocol to other surgical procedures within the Department of Gynecology and surgical departments.

The osteopathic philosophy highlights the body as a whole, with each component being independently important in healing. By utilizing ERAS protocols to optimize each organ system to work at its fullest capacity, such as minimizing nasogastric tubes, early ambulation, and early feeding, the ERAS protocol aligns with the tenet of the body as self-healing as we optimize function as a whole to heal from surgery. Two papers (one by Goldstein et al. [14] and the other by Martingano et al. [15]) showed that osteopathic manipulative treatment (OMT) is safe in the postoperative period as well as in cases of gynecologic-related cancer. Although these papers did not report a significant drop in opioid use postoperatively, there was a trend toward lower opioid use. Another future direction would be to incorporate OMT into the ERAS protocol for further study in opioid reduction.

Overall, the previous literature has shown feasibility in the implementation of ERAS protocols among single institutions [5]. However, unlike previously established studies, we were able to successfully implement this protocol across an entire hospital network. At our multicenter institution, we utilized an ERAS protocol within an EMR order set to increase the ease of use across the network while simultaneously increasing compliance. By implementing this order set, we had a significant reduction in opioid use, and a nonsignificant but clinically relevant reduction in length of stay and hospital cost.

Conclusions

Gynecological oncology ERAS protocols for TAHs are effective in reducing postoperative opioid consumption, length of stay, and cost. Most of the published work on TAH ERAS initiatives on QI has only been demonstrated in single centers, and given that upwards of 84 % of hospitals across the United States are community based, it is critical to

demonstrate that such an initiative can be implemented in a large-scale community setting with similar levels of excellence in postoperative recovery, opioid use reduction, and decreased costs. By utilizing a multidisciplinary approach and an EMR order set to implement an ERAS protocol for TAHs, we were able to demonstrate that the same levels of excellent postoperative recovery seen at single medical centers can be upheld within a large-scale multi-hospital network consisting of both urban and rural settings.

Acknowledgments: To all of our patients, to whom this study could not have been completed without.
Research funding: None reported.
Author contribution: K.E.A., A.N.P., J.S., D.G., A.G., N.T., and I.Z. provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; W.B. drafted the article or revised it critically for important intellectual content; all authors contributed to the analysis and interpretation of data; K.E.A. gave final approval of the version of the article to be published; and all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
Competing interests: None reported.

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