Journal of Clinical Anesthesia 74 (2021) 110378

Contents lists available at ScienceDirect

Journal of Clinical Anesthesia

journal homepage: www.elsevier.com/locate/jclinane

Original Contribution

Institutional factors associated with adherence to enhanced recovery protocols for colorectal surgery: Secondary analysis of a multicenter study

Andres Zorrilla-Vaca [a,b,*], Alexander B. Stone [b], Javier Ripolles-Melchor [c], Ane Abad-Motos [c], Jose M. Ramirez-Rodriguez [d], Patricia Galan-Menendez [e], Gabriel E. Mena [a], Michael C. Grant [f], The Spanish Perioperative Audit and Research Network (RedGERM)Power Investigators Group (including all Researchers participating in POWER Study)

[a] Department of Anesthesiology and Perioperative Medicine, University of Texas MD Anderson Cancer Center, Houston, TX, USA
[b] Department of Anesthesiology, Perioperative, and Pain Medicine, Brigham and Women's Hospital, Boston, MA, USA
[c] Department of Anesthesia and Critical Care, Infanta Leonor University Hospital, Madrid, Spain
[d] Department of Surgery, Lozano Blesa Clinic University Hospital, Zaragoza, Spain
[e] Department of Anesthesiology, Vall d'Hebron University Hospital, Barcelona, Spain
[f] Department of Anesthesiology and Critical Care Medicine, The Johns Hopkins Hospital School of Medicine, Baltimore, MD, USA

ARTICLE INFO

Keywords:
Guideline adherence
Enhanced recovery after surgery
Colorectal surgery
Anesthesiology
Perioperative medicine
Quality improvement

ABSTRACT

Introduction: Adherence to Enhanced Recovery Protocols (ERPs) is associated with faster functional recovery, better patient satisfaction, lower complication rates and reduced length of hospital stay. Understanding institutional barriers and facilitators is essential for improving adherence to ERPs. The purpose of this study was to identify institutional factors associated with adherence to an ERP for colorectal surgery.

Methods: A secondary analysis of a nationwide study was conducted including 686 patients who underwent colorectal surgery across twenty-one institutions in Spain. Adherence to ERPs was calculated based upon the components recommended by the Enhanced Recovery After Surgery (ERAS®) Society. Institutional characteristics (i.e., case volume, ERP duration, anesthesia staff size, multidisciplinary meetings, leadership discipline) were captured from each participating program. Multivariable regression was performed to determine characteristics associated with adherence.

Results: The median adherence to ERAS was 68.2% (IQR 59.1%–81.8%). Multivariable linear regression revealed that anesthesiologist leadership (+5.49%, 95%CI +2.81% to +8.18%, $P < 0.01$), duration of ERAS implementation (+0.46% per year, 95%CI +0.06% to +0.86%, $P < 0.01$) and the use of regular multidisciplinary meetings (+4.66%, 95%CI +0.06 to +7.74%, $P < 0.01$) were independently associated with greater adherence. Case volume (−2.38% per 4 cases weekly, 95%CI -3.03 to −1.74, $P < 0.01$) and number of anesthesia providers (−1.19% per 10 providers, 95%CI +2.23 to −8.18%, $P < 0.01$) were negatively associated with adherence.

Conclusion: Adherence to ERPs is strongly associated with anesthesiology leadership, regular multidisciplinary meetings, and program duration, whereas case volume and the size of the anesthesia staff were potential barriers. These findings highlight the importance of strong leadership, experience and establishing a multidisciplinary team when developing an ERP for colorectal surgery.

1. Introduction

Enhanced Recovery Programs (ERPs) are multidisciplinary initiatives that involve the guideline-driven application of bundled evidence-based interventions applied throughout the individual phases of perioperative care [1]. The objective of ERPs is to accelerate recovery by minimizing the stress response to surgery as well as preventing unintended harm [2–5]. Prior study has shown that overall adherence to ERP elements is associated with improved clinical outcomes, including faster functional recovery, lower rates of surgical and medical complication, and shorter length of stay [2–8]. Although numerous studies have examined its impact, adherence to ERP guidelines has also been shown

* Corresponding author at: Department of Anesthesiology, Perioperative and Pain Medicine, Brigham and Women's Hospital, 74 Francis St, Boston, MA, USA.
E-mail address: andres.zorrilla@correounivalle.edu.co (A. Zorrilla-Vaca).

https://doi.org/10.1016/j.jclinane.2021.110378
Received 8 March 2021; Received in revised form 20 April 2021; Accepted 10 May 2021
Available online 16 June 2021

to be significantly lower outside clinical trial settings and may wane over time [9]. Programs are therefore encouraged to devise and employ durable strategies to improve adherence rates, with the premise of developing a more efficient and efficacious perioperative care model [10–12].

Despite the relationship between guideline adherence and postoperative outcomes, there is still a relatively limited understanding of how to implement a high compliance program. Existing evidence is largely qualitative [13], though strategies such as the use of serial education and formal audit have been shown to improve adherence [14], whereas resource restriction or patient disease complexity represent significant barriers [13]. Often overlooked is the influence of larger institutional or program-level factors, such the leadership identity, team structure, or program size. The purpose of this study was to identify institution-level factors that significantly influence adherence to ERPs guidelines within ERPs for colorectal surgery.

2. Methods

2.1. Study design

The Postoperative Outcomes Within Enhanced Recovery (POWER-1) project was a multicenter, prospective study conducted between September 2017 and December 2017 by the Spanish Perioperative Audit and Research Network (RedGERM), registered (NCT03012802) and approved by the IRB Instituto Aragones de Ciencias de la Salud Ethics Committee (Zaragoza, Spain). The results of the original study, which examined the nationwide impact of enhanced recovery on patient outcomes, were previously published [15]. This study involved a secondary analysis of the POWER-1 dataset. This report follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline. Written informed consent was obtained from the institutions/participants and all the data was encrypted following appropriate standards of confidentiality.

2.2. Inclusion and exclusion criteria

We included patients who underwent elective colorectal surgery at self-reported ERP institutions. These institutions were required to establish an approved ERP, deployed with a dedicated multidisciplinary team. All programs completed a baseline electronic survey to capture certain program or institution-level factors including leadership discipline, number of anesthesia providers, program duration, case volume, as well as the presence of multidisciplinary meetings. Leadership was designated as the individual with administrative oversight, whose role is establish the global infrastructure of the program, allocate resources, and champion the program at the institutional level. Adherence, or compliance, is the percentage of ERAS components that were successfully administered to each patient. Multidisciplinary meetings, at a minimum, consisted of gathering of multiple subspecialties utilized to establish objectives, monitor progress and discuss and mitigate any barriers to program success. The survey was completed by the designated ERP leader from each institution. Confidentiality of the data was maintained through de-identification and password protection. Exclusion criteria included programs with any enrollment interruptions, lack of institutional information or failure to account for patient-level adherence or outcome data.

2.3. ERPs and institutional organization

All institutions implemented standardized ERP measures including 21 interventions as recommended by the Enhanced Recovery After Surgery (ERAS®) Society [16] divided into a number of separate domains including: patient education, bowel preparation, *nil* per os (NPO) status, anesthetic selection, multimodal analgesia, fluid administration, temperature regulation, early ambulation and feeding, and glucose control. A full description of ERPs components is detailed in prior publication [15]. In Spain, ERPs utilize a hierarchically organization, with an administrative physician champion who coordinates clinical teams comprised of multiple disciplines (i.e., anesthesiologists, surgeons, nurses, nutritionists, physical therapists). These teams received formal training on program interventions and administer care based upon institutional ERP guidelines. Care elements are typically adopted in accordance to local contexts, with institutions permitted to employ individualized implementation and auditing procedures.

2.4. Co-variables

We extracted sociodemographic and baseline clinical characteristics of patients including American Society of Anesthesiologists (ASA) physical status, type of colorectal surgery, surgical approach, and medical comorbidities. Institutional characteristics were abstracted into categories including years of program duration, and case volume (per 4 cases weekly), number of anesthesia providers (per 10 anesthesiologists). These cutoffs were defined based on natural distribution of the data and clinical relevance. Results were not significantly altered when assessing alternative cutoffs. Data was collected and managed using REDCap (Research Electronic Data Capture) and our database incorporated automated checks for plausibility, consistency and completeness [15].

2.5. Statistical analyses

An initial exploratory analysis was performed using relative frequencies to represent categorical variables and medians (with interquartile ranges [IQR]) or means (with standard deviations [SD]) for continuous variables based on the distribution of the data. Adherence to ERPs was calculated based on the components recommended by the Enhanced Recovery After Surgery (ERAS®) Society and categorized in quartiles (high [≥78%], medium [68.3%–77.9%], low [54.6%–68.2%], poor [≤54.5%]). Univariable analysis was performed to assess the association between each institutional factor and overall adherence. Chi-square (χ^2) test was used for categorical variables and Wilcoxon signed-rank test for skewed continuous variables. Multivariable linear regression was used to estimate the association between institutional factors and program element adherence. Robust regression estimators were used in the analysis to account for the lack of normal distribution of the data. Multicollinearity was assessed using variance inflation factors for each covariate. The multivariable model included statistically significant variables based on the univariate analysis ($P < 0.05$). P value less than 0.05 was considered statistically significant. All analyses were performed in Stata 14.0 (Statacorp, College Station, TX).

3. Results

3.1. Patient and institutional characteristics

A total of 686 patients across 21 institutions were included in this analysis. All patients underwent colorectal surgery, of which 57% was laparoscopic and 43% open technique. The most common surgical procedures were anterior rectum resection (173, 25.3%), right hemicolectomy (175, 25.6%), and sigmoidectomy (146, 21.4%). The median age of the patients was 68 years [IQR, 59–77], 60.8% were male patients, and 63% classified as ASA status I/II. All institutions were public university hospitals with both anesthesia and surgical residency training programs, with the exception of one, which was public affiliated. All ERPs were directed by physicians, of which 11 (52%) were anesthesiologist and 10 (48%) surgeon-led. The median program duration was 4 [IQR 2–6] years. The median number of colorectal cases was 5 per week [IQR 4–8]. 15 institutions (72%) had regularly scheduled multidisciplinary meetings – 2 reported meetings every month, 5 with meetings every 6 months, 8 with annual meetings and 6 institutions reported that

they never have meetings. With the exception of 4 programs, all institutions employed program coordinators.

3.2. Overall guideline adherence

The median adherence to ERPs was 68.2% (interquartile range [IQR] 59.1% - 81.8%). Based on univariable analysis, anesthesiology leadership was associated with greater adherence to ERP guideline interventions. A greater proportion of cases were categorized high adherence in anesthesiology led programs (Fig. 1; 40.6% vs 27.9%, $P < 0.01$) compared to those with surgical leadership. Programs led by anesthesiologists were more likely to avoid sedatives (96% vs 73%, $P < 0.01$), administer postoperative nausea and vomiting (PONV) prophylaxis (97% vs 92%, $P = 0.01$), avoid routine drains (89% vs 67%, $P < 0.01$), maintain normoglycemia (82% vs 70%, $P < 0.01$), ensure early mobilization (53% vs 45%, $P = 0.03$), and provide early feeding (50% vs 41%, $P = 0.02$) compared to programs led by a surgeon. Programs led by a surgeon were more likely to implement minimally invasive surgical technique (69% vs 59%, $P < 0.01$) and provide formal patient education (84% vs 74%, $P < 0.01$) compared to their counterparts (Supplemental Table 1). Program duration greater than 4 years (72.7% [IQR, 59.1–86.4] vs 63.6% [IQR, 54.5–72.7]; $P < 0.01$) and regular multidisciplinary meetings (72.7% [IQR, 59.1–81.8] vs 63.6% [IQR 54.5–72.7], $P < 0.01$), were associated with increased adherence to ERP guidelines. (See Table 1.)

3.3. Multivariate analysis

Multivariate linear regression revealed that anesthesiology leadership (+5.49%, 95%CI +2.81% to +8.18%, $P < 0.01$), program duration (+0.46% per year, 95%CI +0.06% to +0.86%, $P < 0.01$; Fig. 2) and the use of regular multidisciplinary meetings (+4.66%, 95%CI +0.06 to +7.74%, $P < 0.01$) was associated with greater adherence. Case volume (−2.38% per 4 cases weekly, 95%CI -3.03 to −1.74, $P < 0.01$) and number of anesthesia providers (−1.19% per 10 providers, 95%CI +2.23 to −8.18%, $P < 0.01$) was associated with poorer overall adherence (Table 2). There was no evidence of multicollinearity in the multivariable model.

Table 1
Univariable analysis of institutional factors and ERP adherence.

Institutional factor	Number of institutions (n = sample size)	ERAS compliance, % [IQR]	P value
Level of ERP compliance			
Quartile 4 – Poor	3 ($n = 117$)	≤54.5	
Quartile 3 – Low	8 ($n = 164$)	54.6–68.2	
Quartile 2 – Medium	3 ($n = 181$)	68.3–77.9	
Quartile 1 – High	7 ($n = 224$)	≥78.0	
Years of ERP implementation			
≤3	7 ($n = 231$)	63.6 [54.5–72.7]	Ref.
4–8	10 ($n = 332$)	72.7 [59.1–86.4]	<0.01
9–15	4 ($n = 123$)	72.7 [63.6–77.3]	<0.01
Number of anesthesiologists			
≤40	6 ($n = 173$)	68.2 [59.1–77.3]	Ref.
41–60	6 ($n = 182$)	59.1 [50.0–68.2]	<0.01
60–79	6 ($n = 228$)	77.3 [65.9–86.4]	<0.01
80–98	3 ($n = 103$)	68.2 [54.5–86.4]	1.00
Volume of cases per week			
≤4	8 ($n = 238$)	77.3 [63.6–86.4]	Ref.
5–9	8 ($n = 262$)	72.7 [59.1–86.4]	<0.01
≥10	5 ($n = 186$)	59.1 [54.5–68.2]	<0.01
Specialty leading ERP			
Surgery	10 ($n = 345$)	68.2 [59.1–77.3]	Ref.
Anesthesiology	11 ($n = 341$)	72.7 [59.1–86.4]	<0.01
Multidisciplinary meetings			
Never	6 ($n = 197$)	63.6 [54.5–72.7]	Ref.
Often	15 ($n = 489$)	72.7 [59.1–81.8]	<0.01
Presence of coordinator			
No	4 ($n = 125$)	77.3 [63.6–86.4]	Ref.
Yes	17 ($n = 561$)	68.2 [59.1–81.8]	<0.01

ERPs: Enhanced Recovery Protocols, ERAS: Enhanced Recovery After Surgery, IQR: Interquartile range.

3.4. Qualitative analysis

Continuous rotation of medical personnel was the most common barrier of ERP adherence expressed by 12 (57%) institutions, followed by limited resources (10, 47%) and resistance of cultural changes by

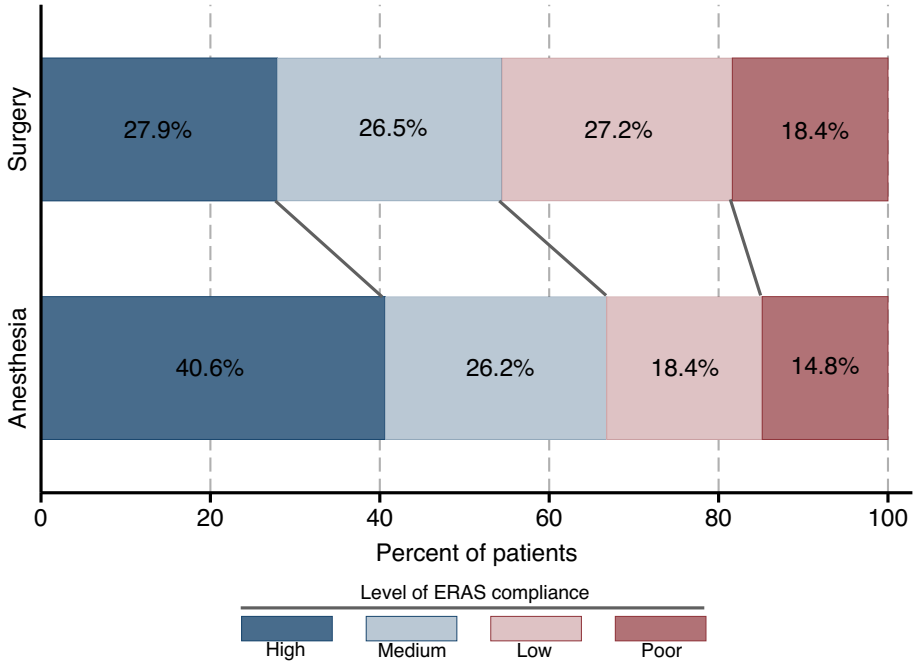

Fig. 1. Bar plot comparing the proportion of each level of ERP adherence stratified by program leadership discipline.

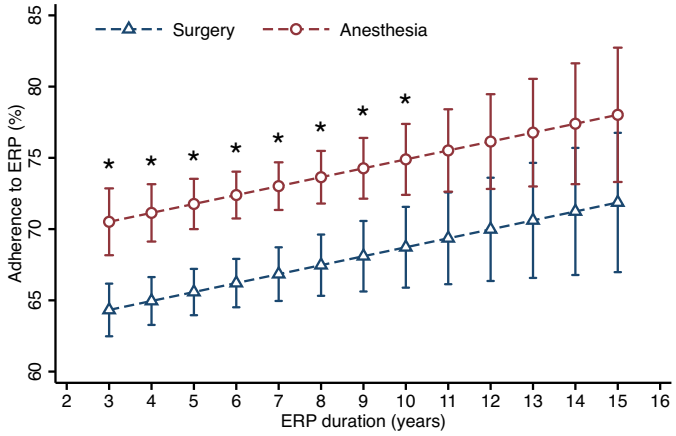

Fig. 2. Relationship between years of ERP implementation and adherence among programs led by anesthesiology versus surgery.

Table 2
Multivariable linear regression analysis of institutional factors and ERP adherence.

Institutional factor	Effect on adherence (95%CI)	*P* value
Anesthesiologist leading ERPs (vs surgeon)	↑ 5.49% (+2.81% to +8.18%)	<0.01
↑ Volume of weekly cases (per 4)	↓ 2.38% (−3.03% to −1.74%)	<0.01
↑ Years of ERP implementation (per year)	↑ 0.46% (+0.06% to +0.86%)	<0.01
Multidisciplinary meetings	↑ 4.66% (+1.57% to +7.74%)	<0.01
↑ Number of anesthesiologists (per 10)	↓ 1.19% (−2.23% to −8.18%)	0.03
Presence of coordinator/Audit	↓ 2.81% (−6.05% to +0.42%)	0.09

ERPs: Enhanced Recovery Protocols, CI: confidence interval.

medical personnel (10, 47%). More details regarding qualitative factors are provided in the Supplemental Table S2.

4. Discussion

Our study assessed the association between institutional or program-level factors and adherence to ERP guidelines. Our findings suggested that facilitators of adherence include anesthesiology leadership, scheduled multidisciplinary meetings, and program duration; whereas case volume and number of anesthesia providers were barriers to adherence with ERP guidelines. To our knowledge, although others have inferred a relationship between certain system-level factors and ERP implementation [11,17], this is the first multicenter study that evaluates the association between institutional factors and adherence to ERP guidelines for colorectal surgery.

A prior systematic review utilized the Consolidated Framework for Implementation Research (CFIR), which categorizes barriers and facilitators of ERP implementation into individual domains which include: (1) characteristics of the interventions, (2) inner setting, (3) outer setting, (4) patient-level characteristics, and (5) implementation process [13]. Although it provides a holistic schema for a successful implementation of ERPs, this classification is largely derived from qualitative research (i.e., cross sectional studies and systematic reviews) and the effect size of individual factors is unknown [13]. The present study focuses largely on the second domain, the inner setting, which "includes the structural, political, and cultural contexts of the organization". The results showed that several institutional factors (i.e., leadership, communication, staffing, and resource allocation) may not only play an important role for implementation as shown in the prior systematic review, but also influence adherence with ERP interventions.

A national survey conducted in Spain showed that 73% of the hospitals had implemented ERPs by 2014, and only 42% of the medical personnel was familiar with associated guidelines [18]. Most of the programs were established by Departments of Surgery (67%), and far fewer by Departments of Anesthesiology (22%) [18]. Our study revealed that the number of programs led by a surgeon was similar to the number of programs led by an anesthesiologist. Interestingly, anesthesia leadership was found to be a facilitator of overall ERP adherence. There are a few potential explanations for this finding. Upon stratified analysis, anesthesiology-led programs reported higher compliance with components traditionally influenced by anesthesia personnel (i.e., avoidance of preoperative sedatives, antibiotic and PONV prophylaxis), while surgeon-led programs yielded better adherence to items directly influenced by surgical personnel (i.e., minimally invasive techniques). It may well be that the improvement in overall adherence associated with anesthesiology leadership can be attributed to the predominance of anesthesia-influenced components in the POWER-1 study [15]. Alternatively, anesthesiology leadership may align more readily with existing loco-regional clinical and administrative roles, particularly across Spain, and different leadership identity may strengthen program adherence in other settings. Finally, it may well be that anesthesiology represents a uniquely challenging group of providers to garner support, and as at least one prior review asserts [13], anesthesiology leadership engagement, in particular, engenders greater commitment to the overall program goals. Additional research would be necessary to determine the association between dual leadership (i.e., multiple disciplines) and adherence to an ERP.

According to the CFIR framework, the inner setting also deals with provider networks and communication, central to which is the establishment of effective collaboration and creating a community of practice among all involved disciplines [13]. Several guidelines recommend that in addition to asserting the importance of evidence-based technical interventions, it is just as vital to make "adaptive changes" to individual programs based upon local context [19,20]. Many of these changes recognize the importance of engagement of the frontline provider, heightened communication and strategic deployment of key resources [13,21]. Previous studies have addressed the importance of teamwork, including the concerted development of dedicated provider groups and leveraging clinical experience with specific surgical care programs to ensure better outcomes [22,23]. Our findings reinforce this prior work, in that regular multidisciplinary meetings, which improve communication across disciplines, as well as program duration, a surrogate for experience, are associated with improved program adherence. Based on our local experience, multidisciplinary meetings should include: (1) education and feedback in form of direct program auditing, (2) utilize a team-based approach to identify barriers to program implementation,

and (3) discuss necessary improvements and iteration to care protocols. A recent survey revealed that roughly 70% of ERP providers in Spain expressed the need for continuing medical education activities [18], though additional adaptive change would need to address not only how medical institutions in Spain organize teams, pay for resources, and educate medical personnel [24], but be cognizant of local organizational structure, communication and resource allocation.

According to our results, case volume and number of anesthesiologists represent barriers to adherence with ERP guidelines. Standardization of healthcare delivery can be challenging in large institutions due to logistical complexities, diverse clinical practice and difficulties in establishing consensus among anesthesia staff [25]. The size of the program or workforce may also be a surrogate for excessive workload, which has been shown to be an important determinant of lack of adherence to clinical guidelines in other settings [26]. One hypothesis for our finding is that standardization of anesthesia practice is more difficult to achieve with larger staff sizes due to increased variability of individual perspectives and experiences. Similarly, high case volume may be responsible for lower adherence rates due to workload constraints as well as patient or procedure variability, which may negatively impact the execution of care planning and perioperative intervention.

Adherence has been approached in different ways using either interactive or purely academic tools through continuing medical education. For instance, Beyer-Berjot et al. implemented a simulation-based care pathway training curriculum for residents, which led to substantial improvement in adherence to ERP guidelines [27]. Smirk et al. was able to improve adherence with anesthesia-related ERP components by incorporating a visual feedback tool (i.e., Navy-based greenie board), which displayed a color-coded score of compliance prior to surgery [28]. Yet another potential method includes patient engagement using mobile device applications [29], which has been shown to reduce workload for medical personnel [30].

There are several important limitations to this study. First, our analysis was not adjusted for patient-level characteristics, particularly low socioeconomic status [31], elderly, malignancy, and opioid tolerance [32], which have shown to have variable impact on ERP compliance. However, generalizability is strengthened by the fact that the study incorporates results from more than 20 hospitals across Spain. While we evaluate a number of relevant program-level factors, there are several uncaptured variables related to institutional resources (i.e., financial payor mix, government resource allocation), provider teams (i.e., team size, provider makeup) or education (i.e., in-service method, schedule) that may also influence adherence rates. The median number enrolled by each institution was relatively low (40 patients), which may not be fully representative of the typical patient at a given institution and limited the statistical power of the analysis. However, over the several month recruitment period, more than 90% of potential participants were included, suggesting a broad sampling of the population nonetheless. Additionally, our results may be subject to Hawthorne effect, which may impact adherence to certain protocols, particularly given the short duration of the study.

Based upon the analysis of patients enrolled in a multicenter ERP for colorectal surgery in Spain, anesthesiology leadership, scheduled multidisciplinary meetings, and program duration were facilitators, whereas case volume and number of anesthesia providers were barriers to adherence with ERP guidelines. While additional study is necessary to validate these results in other national settings, the findings may serve as the basis for future quality improvement initiatives and provide a roadmap for adaptive program-level changes necessary to enhance overall ERP guideline adherence.

Author's contribution

- **Andres Zorrilla-Vaca, MD**: This author designed the study, helped write the manuscript, extracted data, performed statistical analysis, interpreted the results and approved the final manuscript.
- **Alexander Stone, MD**: This author helped write the manuscript, reviewed, edited, interpreted the results and approved the final manuscript.
- **Javier Ripolles-Melchor, MD**: This author helped write the manuscript, data curation, project administration, extract data, interpret the results and approved the final manuscript.
- **Ane Abad-Motos:** This author helped write the manuscript, collected data, supervised the project, interpreted the results and approved the final manuscript.
- **Jose M Ramirez:** This author helped reviewing and reviewing and editing the manuscript, interpreted the results, supervised the project, and approved the final manuscript.
- **Patricia Galan-Menendez:** This author helped reviewing and editing the manuscript, interpret the results, supervised the project, and approved the final manuscript.
- **Gabriel E Mena, MD**: This author helped reviewing reviewing and editing the manuscript, interpret the results and approved the final manuscript.
- **Michael C Grant, MD MSE**: This author helped reviewing and editing the manuscript, interpret the results and approved the final manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-for-profit sectors.

Declaration of Competing Interest

Michael Grant receives salary support from the Agency for Healthcare Research and Quality (AHRQ; HHSP233201500020I) and he served on the execute board of the ERAS Cardiac Society. Gabriel Mena has an academic grant from Pacira Pharmaceuticals. Javier Ripolles-Melchor receives honoraria as a consultant for Edwards Lifesciences and Fresenius Kabi. All other authors have no competing interests.

Acknowledgements

To the members of the Spanish Perioperative Audit and Research Network (RedGERM) and directors who diligently answered electronic surveys for this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclinane.2021.110378.

References

[1] Gustafsson UO, Scott MJ, Hubner M, et al. Guidelines for perioperative Care in elective colorectal surgery: enhanced recovery after surgery (ERAS®) society recommendations: 2018. World J Surg 2019;43:659–95.
[2] Grant MC, Pio Roda CM, Canner JK, et al. The impact of anesthesia-influenced process measure compliance on length of stay: results from an enhanced recovery after surgery for colorectal surgery cohort. Anesth Analg 2019;128:68–74.
[3] Hartman A, Leonard D, Trefois C, et al. Good compliance to enhanced recovery program improves outcome after colorectal surgery. Surg Endosc 2020.
[4] Wei IH, Pappou EP, Smith JJ, et al. Monitoring an ongoing enhanced recovery after surgery (ERAS) program: adherence improves clinical outcomes in a comparison of three thousand colorectal cases. Clin Surg 2020;5.
[5] Byrne BE, Faiz OD, Bottle A, Aylin P, Vincent CA. A protocol is not enough: enhanced recovery program-based care and clinician adherence associated with shorter stay after colorectal surgery. World J Surg 2021;45:347–55.
[6] Grant MC, Isada T, Ruzankin P, et al. Opioid-sparing cardiac anesthesia: secondary analysis of an enhanced recovery program for cardiac surgery. Anesth Analg 2020;131:1852–61.
[7] Grant MC, Isada T, Ruzankin P, et al. Results from an enhanced recovery program for cardiac surgery. J Thorac Cardiovasc Surg 2020;159. 1393–1402.e7.
[8] Pecorelli N, Hershorn O, Baldini G, et al. Impact of adherence to care pathway interventions on recovery following bowel resection within an established enhanced recovery program. Surg Endosc 2017;31:1760–71.

[9] Ahmed J, Khan S, Gatt M, Kallam R, MacFie J. Compliance with enhanced recovery programmes in elective colorectal surgery. Br J Surg 2010;97:754–8.
[10] Pickens RC, Cochran AR, Lyman WB, et al. Impact of multidisciplinary audit of enhanced recovery after surgery (ERAS)® programs at a single institution. World J Surg 2021;45:23–32.
[11] Currie A, Soop M, Demartines N, Fearon K, Kennedy R, Ljungqvist O. Enhanced recovery after surgery interactive audit system: 10 Years' experience with an international web-based clinical and research perioperative care database. Clin Colon Rectal Surg 2019;32:75–81.
[12] Simpson JC, Moonesinghe SR, Grocott MPW, et al. Enhanced recovery from surgery in the UK: an audit of the enhanced recovery partnership programme 2009-2012. Br J Anaesth 2015;115:560–8.
[13] Stone AB, Yuan CT, Rosen MA, et al. Barriers to and facilitators of implementing enhanced recovery pathways using an implementation framework: a systematic review. JAMA Surg 2018;153:270.
[14] Grant MC, Galante DJ, Hobson DB, et al. Optimizing an enhanced recovery pathway program: development of a postimplementation audit strategy. Jt Comm J Qual Patient Saf 2017;43:524–33.
[15] Ripollés-Melchor J, Ramírez-Rodríguez JM, Casans-Francés R, et al. Association between use of enhanced recovery after surgery protocol and postoperative complications in colorectal surgery: the postoperative outcomes within enhanced recovery after surgery protocol (POWER) study. JAMA Surg 2019;154:725–36.
[16] Elias KM, Stone AB, McGinigle K, et al. The reporting on ERAS compliance, outcomes, and elements research (RECOvER) checklist: a joint statement by the ERAS® and ERAS® USA societies. World J Surg 2019;43:1–8.
[17] Pearsall EA, McLeod RS. Enhanced recovery after surgery. Surg Clin North Am 2018;98:1201–10.
[18] Ripollés-Melchor J, Casans-Francés R, Abad-Gurumeta A, et al. Encuesta nacional sobre cirugía con recuperación intensificada. Rev Esp Anestesiol Reanim 2016;63:376–83.
[19] Francis NK, Walker T, Carter F, et al. Consensus on training and implementation of enhanced recovery after surgery: a Delphi study. World J Surg 2018;42:1919–28.
[20] Brindle M, Nelson G, Lobo DN, Ljungqvist O, Gustafsson UO. Recommendations from the ERAS® society for standards for the development of enhanced recovery after surgery guidelines. BJS Open 2020;4:157–63.
[21] Ban KA, Gibbons MM, Ko CY, et al. Evidence review conducted for the agency for healthcare research and quality safety program for improving surgical care and recovery: focus on anesthesiology for colorectal surgery. Anesth Analg 2019;128:879–89.
[22] Saager L, Ruetzler K, Turan A, , et alOften Do It. Do it better: association between pairs of experienced subspecialty anesthesia caregivers and postoperative outcomes. a retrospective observational study. Anesth Analgesia 2021. https://doi.org/10.1213/ANE.0000000000005318 [Internet]. [cited 2021 Feb 9].
[23] Grant MC, Hanna A, Benson A, et al. Dedicated operating room teams and clinical outcomes in an enhanced recovery after surgery pathway for colorectal surgery. J Am Coll Surg 2018;226:267–76.
[24] Arroyo A, Ramirez JM, Callejo D, et al. Influence of size and complexity of the hospitals in an enhanced recovery programme for colorectal resection. Int J Color Dis 2012;27:1637–44.
[25] Ahmed J, Khan S, Lim M, Chandrasekaran TV, MacFie J. Enhanced recovery after surgery protocols - compliance and variations in practice during routine colorectal surgery: enhanced recovery after surgery protocols. Color Dis 2012;14:1045–51.
[26] Jam R, Mesquida J, Hernández Ó, et al. Nursing workload and compliance with non-pharmacological measures to prevent ventilator-associated pneumonia: a multicentre study. Nurs Crit Care 2018;23:291–8.
[27] Beyer-Berjot L, Pucher P, Patel V, et al. Colorectal surgery and enhanced recovery: impact of a simulation-based care pathway training curriculum. J Visc Surg 2017;154:313–20.
[28] Smirk AJ, Nicholson JJ, Console YL, et al. The enhanced recovery after surgery (ERAS) greenie board: a navy-inspired quality improvement tool. Anaesthesia 2018;73:692–702.
[29] Schlund D, Poirier J, Bhama AR, et al. Value of an interactive phone application in an established enhanced recovery program. Int J Color Dis 2020;35:1045–8.
[30] Mata J, Pecorelli N, Kaneva P, et al. A mobile device application (app) to improve adherence to an enhanced recovery program for colorectal surgery: a randomized controlled trial. Surg Endosc 2020;34:742–51.
[31] Leeds IL, Alimi Y, Hobson DR, et al. Racial and socioeconomic differences manifest in process measure adherence for enhanced recovery after surgery pathway. Dis Colon Rectum 2017;60:1092–101.
[32] Owodunni OP, Zaman MH, Ighani M, et al. Opioid tolerance impacts compliance with enhanced recovery pathway after major abdominal surgery. Surgery 2019;166:1055–60.