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Association of Integrated Care Coordination With Postsurgical Outcomes in High-Risk Older Adults
The Perioperative Optimization of Senior Health (POSH) Initiative

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Supplemental content

IMPORTANCE Older adults undergoing elective surgery experience higher rates of preventable postoperative complications than younger patients.

OBJECTIVE To assess clinical outcomes for older adults undergoing elective abdominal surgery via a collaborative intervention by surgery, geriatrics, and anesthesia focused on perioperative health optimization.

DESIGN, SETTING, AND PARTICIPANTS Perioperative Optimization of Senior Health (POSH) is a quality improvement initiative with prospective data collection. Participants in an existing geriatrics-based clinic within a single-site academic health center were included if they were at high risk for complications (ie, older than 85 years or older than 65 years with cognitive impairment, recent weight loss, multimorbidity, or polypharmacy) undergoing elective abdominal surgery. Outcomes were compared with a control group of patients older than 65 years who underwent similar surgeries by the same group of general surgeons immediately before implementation of POSH.

MAIN OUTCOMES AND MEASURES Primary outcomes included length of stay, 7- and 30-day readmissions, and level of care at discharge. Secondary outcomes were delirium and other major postoperative complications. Outcomes data were derived from institutional databases linked with electronic health records and billing data sets.

RESULTS One hundred eighty-three POSH patients were compared with 143 patients in the control group. On average, patients in the POSH group were older compared with those in the control group (75.6 vs 71.9 years; $P < .001$; 95% CI, 2.27 to 5.19) and had more chronic conditions (10.6 vs 8.5; $P = .001$; 95% CI, 0.86 to 3.35). Median length of stay was shorter among POSH patients (4 days vs 6 days; $P < .001$; 95% CI, −1.06 to −4.21). Patients in the POSH group had lower readmission rates at 7 days (5 of 180 [2.8%] vs 14 of 142 [9.9%]; $P = .007$; 95% CI, 0.09 to 0.74) and 30 days (14 of 180 [7.8%] vs 26 of 142 [18.3%]; $P = .004$; 95% CI, 0.19 to 0.75) and were more likely to be discharged home with self-care (114 of 183 [62.3%] vs 73 of 143 [51.1%]; $P = .04$; 95% CI, 1.02 to 2.47). Patients in the POSH group experienced fewer mean number of complications (0.9 vs 1.4; $P < .001$; 95% CI, −0.13 to −0.89) despite higher rates of documented delirium (52 of 183 [28.4%] vs 8 of 143 [5.6%]; $P < .001$; 95% CI, 3.06 to 14.65). A greater proportion of POSH patients underwent laparoscopic procedures (92 of 183 [50%] vs 55 of 143 [38.5%]; $P = .001$; 95% CI, 1.04 to 2.52). Tests for interactions between POSH patients and procedure type were insignificant for all outcomes.

CONCLUSIONS AND RELEVANCE Despite higher mean age and morbidity burden, older adults who participated in an interdisciplinary perioperative care intervention had fewer complications, shorter hospitalizations, more frequent discharge to home, and fewer readmissions than a comparison group.

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The growing number of older adults in the United States presents a specific set of challenges and opportunities for surgeons. Nearly a third of surgical procedures occur in people older than 65 years, a group that makes up about 15.2% of the total US population.[1] Moreover, older adults experience disproportionate rates of postoperative morbidity and mortality.[2-8] Undesirable outcomes exist across many surgical procedures[9-14] and are attributed to higher rates of life-changing postoperative complications.[2,8,15-19]

Postoperative complications likely result in slower recovery, longer postoperative hospital stays, more complex care needs at discharge, loss of independence, and higher readmission rates in the acute postoperative period.[12-18] Increased rates of postoperative complications among older adults are likely attributable to an increased prevalence of chronic comorbidities, as well as less commonly recognized age-related changes in health.[12-18] Established predictors of poor outcomes for all surgical patients include age, multiple chronic conditions, higher American Society of Anesthesia classification, and high-risk or emergency surgeries.[4-8,20,21] However, among older adults, surgical risk is also correlated with other, less routinely measured factors, including functional status, cognition, nutrition, mobility, and recent falls.[22] A number of studies have demonstrated that these factors are predictive of important postoperative outcomes such as length of hospital stay, complication rates, and need for skilled care at discharge.[23,24] Moreover, preoperative geriatric assessment focused on recognizing and addressing these factors can improve outcomes.[25] Cumulatively, this evidence supports the formulation of a different approach to preoperative assessment and postoperative care for this population.

The Perioperative Optimization of Senior Health (POSH) program is an innovative care redesign initiative closely aligned with institutional interests and national health care trends. Using expertise from geriatrics, general surgery, and anesthesia teams at Duke University Hospital, the POSH program provides integrated care coordination for older adults undergoing elective surgeries. The main objective of the POSH program is to improve postoperative outcomes for this high-risk population. The model involves geriatrics experts throughout the perioperative period with specific targeted interventions such as management of comorbidities, reduction of polypharmacy, enhancement of mobility and nutrition, and delirium risk mitigation. This article describes the POSH model and its impact on health outcomes in the postoperative period among older adults.

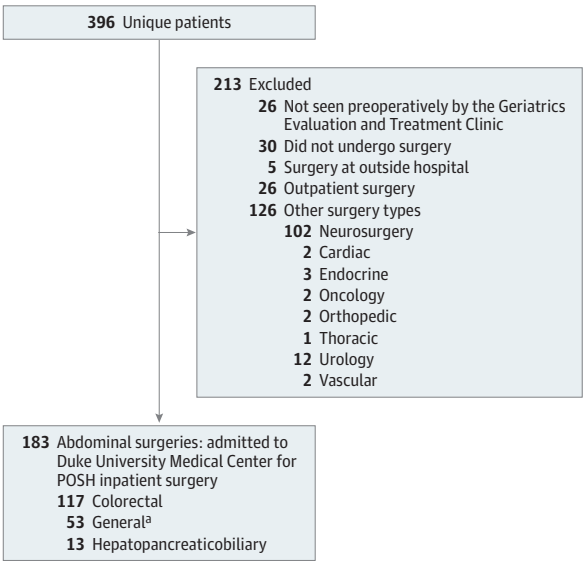
Key Points

Question Do older patients undergoing elective abdominal surgery benefit from participation in coordinated interdisciplinary perioperative care with geriatrics experts?

Findings In this quality improvement case-control study, compared with the control group, older adults participating in the Perioperative Optimization of Senior Health program experienced shorter lengths of stay, had lower readmission rates at 7 days and 30 days, and were more likely to be discharged home with self-care, while experiencing fewer mean number of complications despite higher rates of delirium.

Meaning A comanagement program based on incorporation of geriatric principles and expertise for older adults facing elective abdominal surgery may improve outcomes for this growing high-risk population.

Figure 1. Identification of Perioperative Optimization of Senior Health (POSH) Patient Subgroups



[a] General surgery cases include cholecystectomies, paraesophageal hernia, ventral hernia, and inguinal hernia repairs.

Methods

Overview

Between June 2011 and June 2015, the POSH quality improvement team treated 183 older adults undergoing elective abdominal surgery at Duke University Hospital. Patients were assessed within 30 days before surgery and cotreated by the primary surgical service and consulting geriatrics service throughout their hospitalization. This POSH cohort was compared with a case-matched control group of patients who underwent treatment before the POSH program was implemented. The Duke University School of Medicine institutional review board granted exemption for this quality improvement initiative, and no patient consent was required.

Participants

Figure 1 shows the total number of patients referred to the POSH program during the study period. All surgical candidates 85 years and older undergoing elective colorectal, general, and hepatopancreaticobiliary surgical procedures at Duke University Hospital were referred by the surgeon to the POSH program. Individual surgeons referred patients to POSH at the time of scheduling for surgery. Referral criteria were used to give a framework for identifying older adults considered to be

at higher risk. Patients between age 65 and 84 years were considered eligible when any 1 of the following conditions was present: prior diagnosis of a cognitive disorder, weight loss of more than 4.54 kg in the last year, multimorbidity (presence of 2 or more chronic medical conditions), polypharmacy (more than 5 prescription medications), any visual or hearing impairment, or if the surgeon perceived an increased estimation of risk. This analysis excluded participants who underwent outpatient surgical procedures.

POSH Group

The POSH program began with 4 individual surgeons from the Division of General Surgery collaborating with the geriatrics division. Referred patients were seen in the Geriatric Evaluation and Treatment Clinic for interprofessional preoperative evaluation and care coordination. The POSH preoperative assessment team included a geriatrician, geriatric resource nurse, social worker, program administrator, and nurse practitioner from the Preoperative Anesthesia Testing clinic to complete a comprehensive preoperative geriatric evaluation. The team actively engaged patients and their families in preoperative risk assessment and modification, focusing on specific care points considered crucial for optimizing care: cognition, medications, comorbidities, mobility, functional status, nutrition, hydration, pain, and advanced care planning.[26]

During the preoperative visit with all health care professionals, which typically lasted 60 to 120 minutes, the POSH team offered recommendations for risk-reducing strategies in the preoperative and postoperative periods as well as anticipating needs at discharge. Discussions also included consideration of nonsurgical management options, which for some patients aligned more closely with their personal goals. In the postoperative period, the hospital geriatrics consult team followed patients daily. Physicians who conducted preoperative POSH evaluations also participated in rounds on the inpatient geriatrics consult service. To facilitate implementation of recommendations made before surgery, the inpatient geriatrics team collaborated with the surgical teams, assisting with the management of medications, chronic medical conditions, pain, and recognition and treatment of common postoperative complications, including delirium. The geriatrics and surgery teams also jointly counseled patients and families, helping them prepare for discharge and posthospital care.

Control Group

To analyze the impact of POSH on patient outcomes, we assessed a control cohort of adults older than 65 years who underwent similar surgical procedures as determined by *Current Procedural Terminology* code, performed by the same surgical group, between January 2010 and May 2011. Of note, an Enhanced Recovery after Surgery (ERAS) protocol for colorectal surgery patients was implemented in January 2010, and within this period, all patients eligible for ERAS before and after the initiation of POSH were captured. We analyzed outcomes only from index surgeries, excluding scheduled follow-up procedures (eg, colostomy takedown) and emergency operations.

Study Variables and Data Collection

Data from POSH patients were collected during a standardized preoperative assessment using prescribed intake forms for each discipline. Variables encompassed demographics, surgery information, vital signs (including orthostatics), gait speed, 30-second chair stands, hearing/vision, falls history, self-reported physical activity, Braden Scale score, activities of daily living and instrumental activities of daily living, nutritional status (Mini Nutritional Assessment-Short Form), marital status, social support, advance directives and health care power of attorney, tobacco and alcohol use, medication reconciliation (including anticholinergic cognitive burden and identification of high-risk medications), depression screening, and cognitive screening.[27]

In the POSH group, data were prospectively collected in the preoperative clinic from patient-completed questionnaires or abstracted from the clinic note into a Research Electronic Data Capture database with 10% of the records randomly selected and reviewed for accuracy. No significant data entry errors were identified. Because the control group had no preoperative geriatrics assessment, baseline data for this analysis were collected from administrative data and medical record review using medical record numbers for both POSH and control groups: demographics, social history, the sum of preoperative conditions identified out of 157 chronic comorbid diagnoses selected a priori, and laboratory values before surgery.

Outcomes

Primary outcomes were length of stay (LOS), readmission rates (7-day and 30-day, all-cause inpatient readmission), and discharge disposition (home with self-care vs need for ongoing health services including home health, skilled nursing facility, or hospice). Analysts collected the primary outcomes, coding and exporting data elements for patients in the POSH cohort and the control cohort by using patient-level institutional data from clinical, operational, administrative, and billing systems. Medical record numbers were used to obtain the LOS, readmissions, and discharge disposition. All 7- and 30-day readmission data were verified by medical record review. Complications were obtained using *International Classification of Diseases, Ninth Revision, Clinical Modification* codes associated with the index surgical hospitalization obtained from billing data (eTable in the Supplement).

Secondary outcomes included delirium and other major postoperative complications identified during hospitalization (**Table 1**). For the POSH group, the inpatient geriatrics consult team diagnosed delirium through daily assessment using the Confusional Assessment Method criteria.[28]

Statistical Analysis

Patients in the POSH group were compared with patients in the control group with respect to a set of patient demographics, health use measures, and surgical complications, as described above. For all analyses, the 2 groups were statistically compared using standard bivariate methods, the *t* test for continuous items, and the χ^2 test for categorical data. Because LOS values were not normally distributed, the nonparametric Wil-

Table 1. Postoperative Complications During Hospitalization

Complication Type[a]	No. (%) Control Group (n = 143)	No. (%) POSH Group (n = 183)	*P* Value
Any complication	84 (58.7)	82 (44.8)	<.001
Death	0	1 (0.6)	>.99
Shock			
Hypovolemic, cardiogenic, or postoperative	12 (8.4)	4 (2.2)	<.001
Pulmonary			
Respiratory failure, acute; insufficiency; arrest	21 (14.7)	16 (8.7)	.09
Pneumonia	2 (1.4)	3 (1.6)	>.99
Difficult to wean from ventilator	0	0	>.99
On respirator	2 (1.4)	0	.19
Cardiac			
Acute myocardial infarction	5 (3.5)	3 (1.6)	.31
Cardiac arrest and ventricular fibrillation	2 (1.4)	1 (0.6)	.58
Cardiac dysrhythmias	27 (18.9)	28 (15.3)	.39
Congestive heart failure, acute	11 (7.7)	8 (4.4)	.20
All cardiac combined	45 (23.1)	40 (19.7)	.45
Vascular			
Deep vein thrombosis, acute	3 (2.1)	1 (0.6)	.32
Pulmonary embolism, acute	1 (0.7)	2 (1.1)	>.99
Neurological			
Delirium	8 (5.6)	52 (28.4)	<.001
Acute cerebrovascular disease	4 (2.8)	3 (1.6)	.70
Coma; persistent vegetative state	0	1 (0.6)	>.99
Hematologic			
Bleeding	22 (15.4)	11 (6.0)	<.001
Gastrointestinal			
Nausea; vomiting	5 (3.5)	25 (13.7)	<.001
Ileus	29 (20.3)	9 (4.9)	<.001
Genitourinary			
Urinary tract infection	7 (4.9)	6 (3.3)	.46
Urinary retention	7 (4.9)	11 (6.0)	.66
Renal			
Acute renal failure	13 (9.1)	15 (8.2)	.77
Endocrine			
Hypoglycemia	1 (0.7)	2 (1.1)	>.99
Hyperglycemia	0	5 (2.7)	.07
Alcohol withdrawal	0	0	>.99
In-hospital fall	0	1 (0.6)	>.99
Sepsis or bacteremia	8 (5.6)	4 (2.2)	.10
Integumentary			
Pressure ulcer	5 (3.5)	0	<.001
Wound dehiscence	6 (4.2)	0	<.001
Surgical site infection[a]	8 (5.6)	4 (2.2)	.10
All integument combined	19 (9.8)	4 (2.2)	<.001

Abbreviation: POSH, Perioperative Optimization of Senior Health.

[a] Sepsis and surgical site infection happen to both have the same percentages for the control group and POSH patients. They are, in fact, distinct items; only 2 in the control group and 1 in POSH had both sepsis and surgical site infection.

coxon rank sum test was used for these outcomes instead of the *t* test. Statistical significance was assessed at $P = .05$. Further analysis for all outcomes described in the above section tested interactions between the POSH intervention (POSH vs control) and surgical approach (laparoscopic vs open). For the dichotomous outcomes (7-day and 30-day readmission and discharged home), this interaction analysis was conducted using logistic regression. For the continuous outcome of LOS, it was conducted using Ordinary Least Squares regression of ranks. Multivariate regression for all outcomes using the same regression methods (logistic for dichotomous, ordinary least squares of ranks for LOS) evaluated the sustainability of the POSH main effect in the presence of likely confounders (age, number of comorbid conditions, laparoscopic vs open, and

Table 2. Patient Characteristics at Baseline

Baseline Characteristics	No. (%) Control Group (n = 143)	POSH Group (n = 183)	*P* Value
Age, mean (SD), y	71.9 (6.4)	75.6 (6.8)	<.001
Age, y			
65-69	67 (46.9)	35 (19.1)	<.001
70-74	38 (26.6)	49 (26.8)	
75-84	28 (19.6)	79 (43.2)	
≥85	10 (7.0)	20 (10.9)	
Sex			
Male	73 (51.0)	82 (46.6)	.32
Female	70 (49.0)	98 (54.4)	
Race			
White	101 (70.6)	149 (81.4)	.02
Black	36 (25.2)	29 (15.9)	
Other	6 (4.2)	5 (2.7)	
Marital status			
Single	9 (6.3)	14 (7.8)	.63
Married	82 (57.3)	94 (52.5)	
Divorced	12 (8.4)	22 (12.3)	
Widowed	40 (28.0)	49 (27.4)	
Living alone	NA	54 (29.5)	
Current smoker	2 (1.4)	16 (8.7)	.003
Laboratory values, mean (SD)			
White blood cell count, × 10^9/L[a]	7.7 (2.9)	7.8 (3.4)	.68
Hemoglobin, g/dL[b]	11.9 (2.2)	12.6 (1.9)	.007
Blood urea nitrogen, mg/dL[c]	15.7 (10.0)	18.1 (9.2)	.06
Creatinine, mg/dL[d]	1.0 (0.3)	1.0 (0.3)	.97
Albumin, g/dL[e]	3.6 (0.6)	3.7 (0.4)	.07
ERAS protocol	86 (47.0)	81 (56.6)	.09
Surgery type			
General	32 (22.3)	53 (29.0)	.18
Other[f]	111 (77.6)	130 (71.0)	
Comorbid conditions, mean (SD)	8.5 (7.7)	10.6 (9.7)	.001
Laparoscopic	55 (38.5)	92 (50.3)	.033

Abbreviation: ERAS, Enhanced Recovery After Surgery; NA, not available; POSH, Perioperative Optimization of Senior Health.

SI conversion factor: To convert white blood cell count to × 10^9 per liter, multiply by 0.001; hemoglobin to grams per liter, multiply by 10; blood urea nitrogen to millimoles per liter, multiply by 0.357; creatinine to micromoles per liter, multiply by 76.25; and albumin to grams per liter, multiply by 10.

[a] Data was available for 131 of 143 control patients (91.6%) and 168 of 183 POSH patients (91.8%).

[b] Data was available for 131 of 143 control patients (91.6%) and 166 of 183 POSH patients (90.7%).

[c] Data was available for 131 of 143 control patients (91.6%) and 98 of 183 POSH patients (53.6%).

[d] Data was available for 131 of 143 control patients (91.6%) and 97 of 183 POSH patients (53.0%).

[e] Data was available for 118 of 143 control patients (82.5%) and 153 of 183 POSH patients (83.6%).

[f] Other surgeries for the control group were colorectal cases, and other surgeries for the POSH group included colorectal cases with hepatopancreaticobiliary cases.

ERAS) alone and in combinations for regression modeling. Confounders were selected based on clinically significant baseline differences and ERAS exposure, which could potentially improve outcomes. SAS software, version 9.3 (SAS Institute Inc) was used for all the analyses

Results

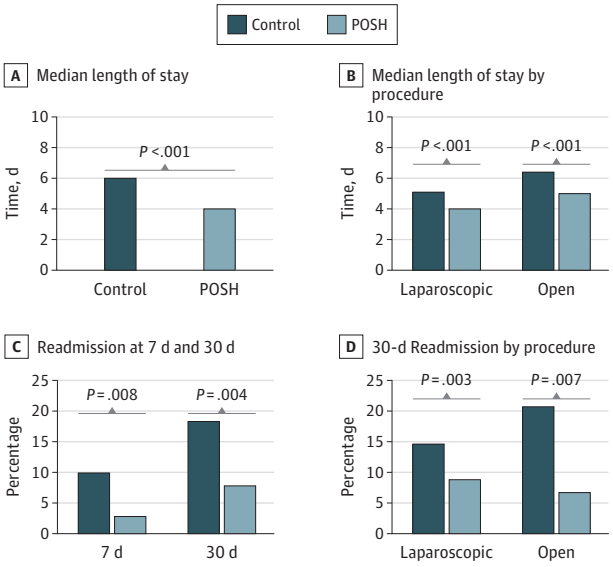
Patient and Surgery Characteristics

Comparison of baseline characteristics of 183 POSH patients and 143 patients in the control group demonstrated that POSH patients were older, including a higher percentage of patients older than age 75 years (**Table 2**). Patients in the POSH group had a higher number of chronic conditions and were more likely to be active smokers. The control group included 111 colorectal surgeries (77.6%) and 32 general surgeries (22.3%) without any hepatopancreaticobiliary surgeries. The POSH group included 117 colorectal and 13 hepatopancreaticobiliary surgeries (71%) and 53 general surgeries (29%). We pooled hepatopancreaticobiliary and colorectal surgeries given similar complexity. Proportions of these surgeries were not statistically significantly different in the 2 groups (*P* = .18; 95% CI, 0.42-1.17). Patients in the POSH group underwent a higher percentage of laparoscopic procedures. Eighty-six of 183 patients in the POSH group underwent ERAS protocol (47%) compared with 62 of 143 in the control group (43%), a difference that did not reach statistical significance (*P* = .08; 95% CI, 0.44-1.05) (Figure 1).

Health Care Service Use

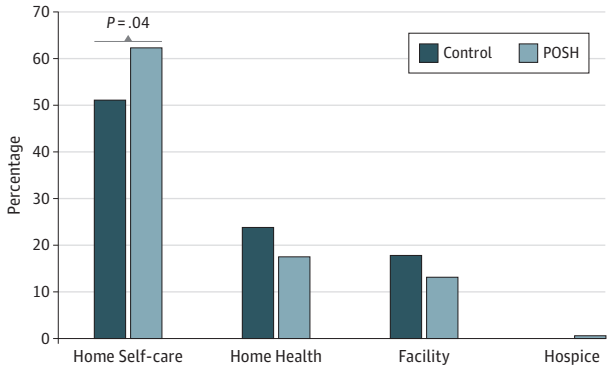
Compared with the control group, POSH patients experienced shorter median LOS (4.0 days [range 1-75] vs 6.0 days [range 1-60]; *P* < .001; 95% CI, 1.1-4.2) (**Figure 2**A). This association persisted after stratification by laparoscopic (4.0 days [range 1-10] vs 5.1 days [range 1-28]; *P* = <.001; 95% CI, 0.9-3.2) and open procedures (5.0 days [range 1-60] vs 6.4 days [range 1-75]; *P* = .01; 95% CI, 0.1-5.2) (Figure 2B).

Figure 2. Median Length of Stay (LOS) and Readmission Rates by Surgical Approach



A, Comparison of median LOS in days for hospitalization for the primary surgery. B, Comparison of median LOS in days for Perioperative Optimization of Senior Health (POSH) patients vs control patients for laparoscopic vs open procedures. C, Comparison of all-cause readmission rates in percentage at 7 days and 30 days after discharge from hospitalization for surgery. D, Comparison of hospital readmission rates in percentage at 30 days for patients with laparoscopic vs open procedures.

Figure 3. Discharge Disposition



Comparison of Perioperative Optimization of Senior Health (POSH) patients and control group patients for location and level of care at discharge from hospitalization for primary surgery. The percentage of all patients discharged to either home with self-care (ie, without home health care or other skilled services) vs a need for ongoing health care services (eg, home health care, skilled nursing or acute inpatient rehabilitation, or hospice). Numbers in hospice included 1 for POSH and 0 for control. *P* value reflects the χ^2 test of home self-care vs all other dispositions.

Patients in the POSH group had lower 7-day (5 of 180 [2.8%] vs 14 of 142 [9.9%]; *P* < .001; 95% CI, 0.09-0.74) and 30-day (14 of 180 [7.8%] vs 26 of 142 [18.3%]; *P* < .001; 95% CI, 0.19-0.75) all-cause readmission rates (Figure 2C). Differences persisted for readmissions within 30 days when stratified by laparoscopic (8 of 90 [8.9%] vs 8 of 55 [14.6%]; *P* = .29; 95% CI, 0.2-1.63) and open surgeries (6 of 90 [6.7%] vs 18 of 87 [20.7%]; *P* < .001; 95% CI, 0.1-0.73) (Figure 2D).

An analysis of care dependency at discharge was performed comparing discharge with home with self-care vs other discharge with skilled services (either home health, facility-based, or hospice) (**Figure 3**). Patients in the POSH group returned home with self-care more frequently than those in the control group (114 of 183 [62.3%] vs 73 of 143 [51.1%]; *P* = .04; 95% CI, 1.02-2.47). Although POSH patients discharged to home required fewer home health services (32 of 183 [17.5%] vs 34 of 143 [23.8%]; *P* = .16; 95% CI, 0.39-1.17) and were less often discharged to a facility (26 of 183 [14.2%] vs 27 of 143 [18.9%]; *P* = .26; 95% CI, 0.39-1.28), these differences were not statistically significant.

The tests of interaction between group (POSH or control) and type of surgery (laparoscopic or open) were nonsignificant for all the outcomes (LOS, 7- and 30-day readmission, and discharged home with self-care). In addition, regression modeling including age, comorbid conditions, surgical approach, and ERAS enrollment revealed that the association of the POSH intervention with LOS, readmission rates at 7 and 30 days, and discharge to home under self-care remained significant in the full model.

Postoperative Complications

Postoperative complications during hospitalization are summarized in Table 1. Fewer POSH patients experienced complications (82 of 183 [44.8%] vs 83 of 143 [58.7%], *P* = .01; 95% CI, 0.37-0.89). Compared with the control group, POSH patients had a lower incidence of postoperative cardiogenic or hypovolemic shock (4 of 183 [2.2%] vs 12 of 143 [8.4%]; *P* = <.001; 95% CI, 0.08-0.77), bleeding during and after surgery (11 of 183 [6.1%] vs 22 of 143 [15.4%]; *P* = <.001; 95% CI, 0.16-0.75), and postoperative ileus (9 of 183 [4.9%] vs 29 of 143 [20.3%]; *P* < .001; 95% CI, 0.09-0.45). However, the POSH cohort experienced higher rates of nausea/vomiting (25 of 183 [13.7%] vs 5 of 143 [3.5%]; *P* = <.001; 95% CI, 1.62-11.71) and had higher rates of documented delirium (52 of 183 [28.4%] vs 8 of 143 [5.6%]; *P* = <.001; 95% CI, 3.06-14.65).

Discussion

The POSH program at Duke University aims to improve outcomes for older adults through an interdisciplinary, person-centered approach to surgical risk mitigation, health optimization, and patient and family caregiver engagement. The model[26] integrates technical expertise across different disciplines and implements care plans across settings throughout the perioperative period. In this article, we described the core elements of the program, including its focus on (1) early identification of risk in the preoperative period, (2) creation of a customized preoperative optimization plan, and (3) postoperative collaborative management by surgery and geriatrics teams. When compared with a control cohort of older adults undergoing similar procedures by the same group of general surgeons, POSH patients experienced a significantly shorter LOS, lower rates of readmission at 7 and

30 days, and a higher rate of discharge to home under self-care, all despite an older mean age and greater burden of medical illness. Further, as evidence of the POSH program's effectiveness, POSH patients experienced lower rates of major complications.

Delirium was identified in POSH patients at higher rates than in the control group, which is not unexpected because high postoperative delirium rates are known to be identified with increased screening.[29] Collaborative care allows for increasing the recognition of geriatric syndromes like delirium, more focus on symptom management, and proactively anticipating complications. We suspect that delirium was present at similar or higher rates in the control group but was underdiagnosed before daily Confusional Assessment Method administrations by the geriatrics team.[30,31] Consistent with well-documented consequences of delirium, our data show that within the POSH group, those with delirium had longer median LOS (5.2 vs 4.0 days) and were less likely to be discharged home (31 of 56 [59.6%] vs 115 of 131 [87.8%]). The impact of POSH on postoperative complications was evident regardless of surgical technique, with POSH patients experiencing a mean of 0.46 fewer complications after either laparoscopic or open procedures. Although LOS increased among POSH patients with delirium, the cohort's overall lower rate of complications and higher likelihood of returning home after surgery suggests that the POSH program's anticipation and management of complications was beneficial.

The POSH program offers an important innovation in comprehensive care of older adults undergoing surgery. It builds on a body of evidence supporting the integration of geriatric principles into both preoperative and postoperative care processes.[25] Prior controlled trials and quasiexperimental studies indicate that preoperative evaluations based on comprehensive geriatrics assessment confer benefits, including reductions in surgical cancellations/delays, lower rates of certain complications, and shorter LOS.[25,32] The POSH process also operationalizes recent preoperative assessment and management guidelines, which recommend specific steps for improving care in several domains, including cognition, nutrition, mobility, medication management, and caregiving.[26,33,34] Postoperative consultation or comanagement by geriatrics teams, have demonstrated value particularly for orthopedic procedures.[35] These studies also documented reductions in complications and LOS. The POSH program integrates evidence for geriatric consultation in preoperative and postoperative periods to provide collaborative care for older adults and is becoming increasingly more efficient with program development.[36]

The POSH program demonstrates feasibility for implementing a perioperative collaborative care initiative comprising multiple disciplines, including surgery, geriatrics, and anesthesia. It also provides a model for bridging the outpatient preoperative setting and postoperative inpatient care via a shared plan of care focused on risk stratification, targeted optimization, and increased vigilance in the postsurgical environment. The improvement in outcomes reported after implementation of POSH is likely due to several innovative components.

First, a person-centered approach to care was used. The POSH program, in close collaboration with attending surgeons, engages patients and families in the perioperative planning process by encouraging attendance at the preoperative visit. Family participation facilitates establishing realistic goals, shared decision making, and advanced care planning. We feel that this person-centered approach contributed to the 8% of those referred patients who decided that nonsurgical management was more consistent with their preferences. Family members were encouraged to play active roles in delirium prevention, bedside attendance, and patient advocacy during hospitalization.

Second, health care professionals worked in multidisciplinary, interprofessional teams. The POSH preoperative assessment is complex, involving evaluation and optimization protocols across a broad range of care points. The program's effectiveness, therefore, relies on active participation and unique perspectives and skill sets of health care professionals from multiple disciplines, which currently include nursing, social work, geriatric medicine, surgery, and anesthesia.

Third, preoperative identification of risk and customized development of prevention and optimization plans was implemented. The POSH program supplements standard preoperative assessment with evaluations of cognition, mood, mobility, nutrition, medications, and social support. This additional information allows for customized optimization and prevention plans, with particular emphasis on improving strength/mobility, enhancing protein/calorie intake, and minimizing use of high-risk medications. Additionally, the POSH team collaborates with other specialty services to obtain necessary preoperative evaluations expeditiously as to not delay surgery. Postoperative care teams receive anticipatory guidance regarding pain and non-pain symptom control, delirium prevention protocols, and guidance regarding safe perioperative management of medications for blood glucose level, blood pressure, and anticoagulation.

Fourth, care across settings and systems was integrated. Program pillars include collaboration and strong lines of communication, both critical to facilitate common goals, reduce redundancy, establish realistic expectations, and improve care transitions from outpatient clinics to acute care settings. This process begins at the initial evaluation. Preoperative notes provide key information and recommendations regarding inpatient care. Detailed preoperative discussions about living situations and potential need for rehabilitation can lead to improvements in patient understanding and outlook at the time of discharge. Recommendations are communicated to the primary care physician to help engage in preoperative optimization and assure safe transitions back to their care.

Fifth, the POSH design and approach to population-based care for older adults provides a model for care bundles that integrate the expertise of surgeons with the global perspective of geriatrics. The process builds in an ongoing review of program quality, in areas from process to patient outcomes, by using standardized data-collection systems via electronic health records. The program design also aligns with principles of value-based health care and lends itself easily to the requirements of new payment models.

Limitations

Our analysis of the clinical impact of the POSH program has important limitations. Admittedly, with its initial focus on development of a complex new process integrating different disciplines and settings, POSH patients were accrued during a longer time than the control group. Additionally, the quasi-experimental design using a control group for comparison raises concerns about potential confounders. With advancements in technology and the accrual of experience among individual surgeons, outcomes from surgical care are likely to improve over time; however, we believe that the 17-month period immediately preceding the initiation of the POSH program represents a contemporary timeframe with little chance of major change in surgical practice or protocols. To further limit potential confounding factors along these lines, we intentionally included control patients who had undergone similar surgery types by the same surgeons. We also attempted to account for other major recent innovations for care improvement—most notably, the implementation of the ERAS protocol—in the timeframe of our inclusion of the control group. During our control period and before the initiation of POSH, the ERAS protocol was routinely available for older adults undergoing elective colorectal surgeries at Duke University Hospital. Importantly, POSH patients did undergo a higher percentage of laparoscopic procedures. This may have represented a change in practice over time or even an effect of the POSH evaluation itself on decisions regarding surgical approaches. Regardless, comparisons of laparoscopic and open approaches revealed similar benefit with respect to the main outcomes. The independent effect of POSH was sustained for the 4 outcomes even with statistical testing in the presence of the likely confounders.

Conclusions

Development of an interdisciplinary perioperative program featuring collaboration between health care professionals in surgery, geriatrics, and anesthesiology and focused on surgical risk mitigation, health optimization, and patient and family caregiver engagement was associated with improved postoperative outcomes for high-risk older adults undergoing elective abdominal surgery. To move this model forward, capturing high-quality data in clinical settings and refining the analyses will be crucial for identifying which elements of team-based care have the greatest impact for complex high-risk populations, thus enabling us to make better decisions about delivery of interventions at appropriate time intervals with respect to elective surgeries and directed toward those with the greatest opportunity for benefit.

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