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RESEARCH

Reducing dehydration-induced readmissions post-colorectal surgery: the impact of a prevention bundle

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Abstract

Introduction Ileostomy, frequently created after colorectal resections, hinders the physiologic function of the colon and can lead to dehydration and acute kidney injury due to high stoma outputs. This study aimed to evaluate the effectiveness of preventive measures on ileostomy-induced dehydration and related readmissions in a high-volume unit.

Methods In this prospective cohort study at a high-volume colorectal surgery department in Turkiye, the Prospective Ileostomy-induced Dehydration Prevention Bundle Project (PIDBP) was assessed from March 2021 to March 2022. The study enrolled patients undergoing colorectal surgery with ileostomy and involved comprehensive inpatient stoma care, education, and a structured post-discharge follow-up. The follow-up included the "Hydration follow-up scale" to monitor ileostomy output and related complications. The primary outcome was the readmission rate due to dehydration-related complications. The patients receiving the bundle intervention were compared with patients treated in the preceding year, focusing on the effectiveness of interventions such as dietary adjustments, fluid therapy, and pharmacological management.

Results In the study, 104 patients were analyzed, divided into 54 pre-bundle and 50 bundle group patients, with no significant differences in patient characteristics. While the overall readmission rate due to dehydration was 12.5%, a significant reduction in dehydration-related readmissions was observed in the bundle group compared to the pre-bundle group (2% vs. 22%, $p=0.002$). Univariate analysis identified high stoma output (> 800 ml/24 h) ($p<0.001$), chronic renal failure (CRF) ($p=0.01$), postoperative ileus ($p=0.03$), higher ASA status ($p=0.04$), extended hospital stays ($p=0.03$), and small bowel resections (especially in J-pouch patients) ($p<0.001$) as significant predictors of readmission. Multivariate analysis revealed that the mean ileostomy output before discharge was the sole significant predictor of dehydration-related readmission (OR 1.01), with an optimal cutoff of 877.5 ml/day identified with an area under the curve (AUC) of 0.947, demonstrating high sensitivity (92.3%) and specificity (86.8%) in predicting readmission risk.

Conclusion The Prospective Ileostomy-induced Dehydration Prevention Bundle Project significantly reduced readmission rates after colorectal surgery.

Keywords Ileostomy · Dehydration · Readmission · Colorectal surgery

Introduction

Ileostomy formation, though effective in reducing morbidity related to colorectal complications, constitutes the highest readmission reason after colorectal resections [1, 2]. Such a diversion hinders the physiologic function of the colon and prevents the reabsorption of fluid and electrolytes from the feces. This malfunction may lead to dehydration, which can lead to further complications, including fluid electrolyte imbalances, acute kidney injury, and cardiac arrhythmias [2–5]. Moreover, the impact of ileostomy-related

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complications on oncological outcomes, particularly by delaying adjuvant treatment, represents a significant yet often underappreciated postoperative complication in colorectal cancer surgery [2]. Given that individuals with an ileostomy are twice as likely to be readmitted as those without, prioritizing the prevention of readmissions post-ileostomy formation is essential. This approach is critical for reducing morbidity rates, optimizing healthcare resource use, and potentially enhancing cancer survival outcomes [6].

As the leading cause of stoma-related readmissions, dehydration warrants increasing awareness of monitoring, and preventive measures are needed due to its potentially avoidable nature [1, 5, 7, 8]. In the current literature, possible risk factors for ileostomy-related hospital readmission are reported as ileal pouch anastomosis, perioperative diuretic use, receiving neoadjuvant therapy for rectal cancer, age > 50, inflammatory bowel diseases, and high ileostomy output [5, 7–9]. The values for high ileostomy output and its current treatment algorithm can be seen in Fig. 1. Many interventions to reduce readmission rates secondary to dehydration have been implemented over the years, with varying levels of evidence and success [10–12]. Various measures of patient education, diet modification, nutritional support, dedicated post-discharge protocols, and pharmacotherapy (Fig. 1) have been used to reduce readmission rates after colorectal surgery in patients with an ileostomy. We assume that adopting more comprehensive evidence-based "bundles" of measures and interventions can be more effective in reducing the readmission rate associated with ileostomy-induced dehydration. This study aimed to investigate the impact of preventive measures on ileostomy-induced dehydration-related complications and readmissions after colorectal resections in a high-volume unit.

Material and methods

Study design

This prospective cohort study, conducted at a high-volume colorectal surgery department in Turkiye, focused on the Prospective Ileostomy-induced Dehydration Prevention Bundle Project (PIDBP). Between March 2021 and March 2022, patients undergoing colorectal surgery with an ileostomy due to conditions such as colorectal cancer, inflammatory bowel diseases, and gynecological cancer were included in this study. Exclusion criteria encompassed those under 18 or over 90 years of age, individuals with mental/psychiatric illnesses or disabilities affecting decision-making, patients with a prior ileostomy/colostomy/urostomy, and non-Turkish/non-English speakers. The study compared ileostomy-related dehydration and complications during this period against the previous year. Ethics committee approval (No. 2021.111.IRB1.034) was obtained, and all patients provided informed consent. The study adhered to the Declaration of Helsinki and good clinical practice principles. The STROBE guidelines were followed in all stages of this study, including design, data collection, analysis, and reporting. This approach ensured that key elements of the research were comprehensively addressed, enhancing the clarity, validity, and reproducibility of the findings.

Medical records of eligible patients were reviewed to collect data on demographics, diagnosis, type of surgery, prior treatments, medications, and kidney function at discharge, including eGFR and serum creatinine levels, as well as preoperative and postoperative albumin, stoma, and urine output.

Patient care and follow-up

All patients received comprehensive inpatient stoma care and education, including a detailed follow-up brochure. Post-discharge care involved regular telephonic follow-ups by stoma care nurses.

PIDBP design and implementation

The PIDBP was overseen by a team comprising colorectal surgeons, a nurse manager, stoma/wound care nurses, and dietitians. This team evaluated patients after surgery to minimize ileostomy-related complications and assessed the effectiveness of the project in monthly meetings.

Bundle elements and data capture

PIDBP elements were based on published evidence and included the following: (1) pre-surgery educational meetings and daily post-surgery visits with the stoma therapy team; (2) provision of a comprehensive patient follow-up brochure; (3) eight e-visits within the first 28 days after discharge, covering ileostomy flow rates, urine color, and vital signs. Patients with ileostomy output > 1000 ml/day or showing dehydration symptoms received tailored interventions, including dietary adjustments and fluid replacement. The first step of intervention involved dietary adjustments facilitated by stoma therapy nurses or dietitians. Foods causing watery stoma output were eliminated from the patient's diet; gelatin-containing and stool-thickening foods were introduced [13]. Oral rehydration fluids were administered if a patient continued to exhibit high ileostomy flow rates (> 1000 ml/day) or dehydration symptoms at subsequent assessments [14]. Additionally, these patients were advised to consume isotonic and hypertonic fluids while reducing hypotonic fluid intake and referred to a physician if necessary. Pharmacological intervention commenced with proton pump inhibitors and loperamide,

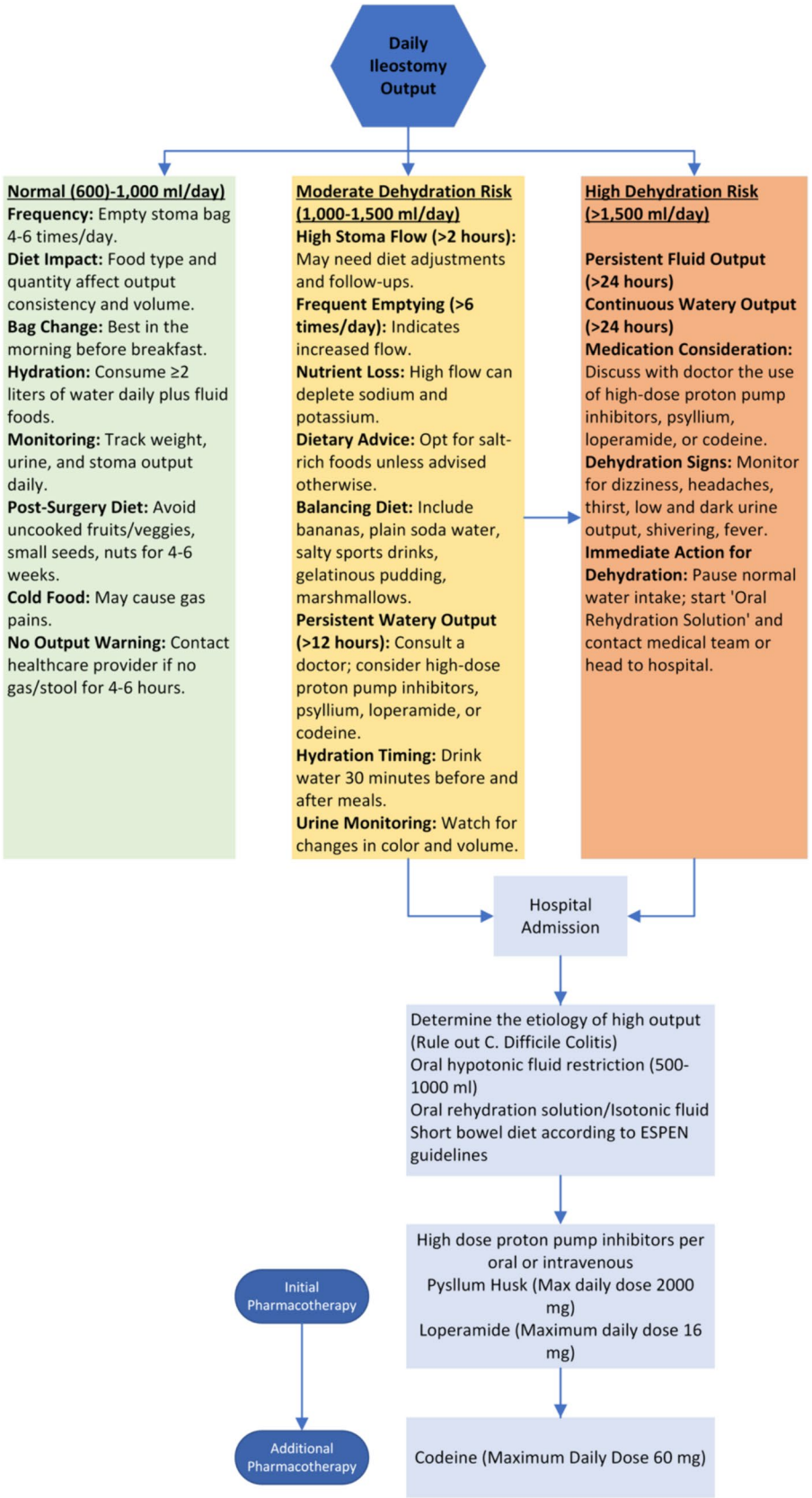


Fig. 1 Measure and treatment algorithm based on the daily ileostomy output

the latter potentially escalating to a maximum dosage of 4 × 4 mg per day if deemed necessary [12, 14–16]. Following this, codeine phosphate was administered in doses ranging from 2 × 10 to 2 × 20 mg daily [12, 14, 17]. Should these conservative and initial medical treatments prove insufficient, patients were invited to the hospital in the outpatient unit for IV hydration. For patients continuing to show high ileostomy output despite these interventions, management followed the medical treatment algorithm detailed in Fig. 1.

Eight telephone calls were made to all patients on the 1st, 3rd, 5th, 7th, 10th, 14th, 21st, and 28th days after their discharge to acquire data for the "Hydration follow-up scale" (Fig. 2). The aim was to track patient progress, covering ileostomy flow rates, urine color, and vital signs. This scale gathered detailed information during each contact, including patients' general condition, vital sign measurements, fluid intake, daily ileostomy output (measured with a jug provided at discharge), consistency of ileal content, and numerically categorized urine color and output. Patients were queried for symptoms, including dizziness, nausea and vomiting, fever, weariness, thirst, and weight loss. Stoma closure for patients not undergoing adjuvant chemotherapy was scheduled for 4 to 8 weeks post-surgery. Conversely, for patients undergoing adjuvant chemotherapy, closure was planned for approximately 12 weeks post-surgery, aligning with the completion of the chemotherapy cycles.

Data collection and outcomes

The primary outcome was readmission rates within 30 days after discharge, focusing on dehydration, kidney function, and acute kidney injury. Data from pre-bundle patients were retrospectively collected from hospital records, while intervention group data were gathered prospectively. Variables included age, BMI, albumin levels, serum creatinine, eGFR, and mean ileostomy outputs in the last 4 days before discharge. The data that support the findings of this study are not openly available. However, the data are available from the corresponding author upon reasonable request. Collected data are located in controlled access data storage at Koc University Hospital.

Sample size calculation

To detect a reduction in hospital admission rates from 10% to approximately 1% with a 5% Type I error (alpha) and 90% power (beta = 0.10), we calculated the necessary sample size using standard statistical methods for comparing two proportions. Based on these criteria, it was concluded that a sample size of 42 patients is required. The calculation was derived from the formula for determining sample size in hypothesis

Date	Time	Weight	Vital Sings			Fluid Intake			Output		Urine Color
			Body Temperature	Pulse	Blood Pressure	Isotonic	Hypertonic	Hypotonic	Stoma	Urine	1 2 3 4 5 6 7

Fig. 2 Hydration follow-up scale

testing for proportions. This method considers the anticipated effect size, significance level, and power of the test. In order to account for possible instances of participants being lost to follow-up or other unexpected situations, we augmented the sample size to include 50 patients.

Statistical analysis

Statistical analyses were performed using IBM SPSS 28.0. The chi-square test was employed to compare categorical variables. The Mann–Whitney *U* test was utilized for non-parametric comparisons of continuous variables that were not normally distributed. The *t*-test was applied to compare normally distributed continuous variables. The significance threshold was set at 0.05.

Selection of variables for multivariate analysis

Variables with a p-value < 0.10 in the univariate analysis investigating their association with readmission due to dehydration were considered for inclusion in the multivariate logistic regression model. This threshold was chosen to ensure that potentially relevant variables were not excluded from the multivariate analysis. A forward stepwise regression model was then used to create an optimal multivariate model. This method involves starting with no variables in the model, testing the addition of each variable one at a time, and keeping those that improve the model's predictive power.

Results

A total of 104 patients who met the inclusion criteria were analyzed in the study. There were 54 (51.9%) in the pre-bundle and 50 patients (48.1%) in the bundle group. The two groups were comparable. Demographic features and perioperative and postoperative variables are shown in Tables 1 and 2. The two groups were comparable in terms of age, sex, and BMI. The highest proportion of patients were operated for rectal cancer in both groups.

Twenty-one (20.2%) of the 104 patients included in the study were readmitted to the hospital. Thirteen of 104 patients (12.5%) were re-hospitalized due to dehydration (Table 3). Four patients in the bundle group were admitted back to the hospital, one for dehydration, one for febrile neutropenia, and two for intraabdominal abscess. In the pre-bundle group, 19 patients were re-hospitalized, including 12 for dehydration, 2 for intra-abdominal abscess, 2 for ileus, one for poor general condition, one for DVT and pulmonary thromboembolism, and 1 for GI bleeding. A statistically significant difference was found between the bundle and pre-bundle groups regarding dehydration and readmission ($p < 0.01$). The bundle group had a lower dehydration-related readmission rate than the pre-bundle group (2% vs. 22%, $p = 0.002$). The association between patients' variables and readmission due to dehydration is shown in Table 4.

The results of our univariate analysis are comprehensively presented in Table 4. Univariate analysis revealed that multiple factors significantly increased the risk of readmission.

Table 1 Demographic variables of patients

	Bundle group $n = 50$	Pre-bundle group $n = 54$	p
Gender			
Male	32 (64%)	22 (40.7%)	
Female	18 (36%)	32 (59.3%)	
Age (± SD)	57.50 ± 15.66	58.28 ± 13.09	0.78
BMI (± SD)	25.95 ± 4.33	24.54 ± 4.91	0.66
ASA classification ($\bar{x}$ ± SD)	2.10 ± 0.58	2.21 ± 0.56	0.34
Diabetes	8 (16%)	12 (22.2%)	0.42
Congestive heart failure	2 (4%)	1 (1.9%)	0.61
Chronic renal insufficiency	3 (6%)	2 (3.7%)	0.67
Preoperative chemotherapy	38 (76%)	40 (74.1%)	0.82
Preoperative radiotherapy	19 (38%)	22 (40.7%)	0.76
Preoperative use of steroids/immunosuppressant medication	8 (16%)	12 (22.2%)	0.42
Smoker	16 (32%)	15 (27.8%)	0.64
Weekend discharge	1 (2%)	8 (14.8%)	0.03
Preoperative diagnosis			
Rectal cancer	41 (82%)	42 (77.8%)	0.59
Inflammatory bowel disease	5 (10%)	6 (11.1%)	
Gynecological cancer	4 (8%)	6 (11.1%)	

Table 2 Perioperative and postoperative variables of patients

	Bundle group $n=50$	Pre-bundle group $n=54$	p
Surgical procedure			
LAR/left hemicolectomy	35 (70%)	33 (61.1%)	0.21
Total/subtotal colectomy	7 (14%)	10 (18.5%)	
Total proctolocolectomy	8 (16%)	8 (14.8%)	
Right hemicolectomy	0	3 (5.6%)	
Procedure type			
Elective	47 (94%)	50 (92.6%)	1.00
Emergent	3 (6%)	4 (7.4%)	
Surgical approach			
Minimally invasive	32 (64%)	31 (57.4%)	0.49
Open	18 (36%)	23 (42.6%)	
Ileostomy type			
Diverting ileostomy	49 (98%)	42 (77.8%)	0.002
End ileostomy	1 (2%)	12 (22.2%)	
Clavien-Dindo score			
Grades I–II	38 (76%)	35 (64.8%)	0.21
Grades III–IV	12 (24%)	19 (35.2%)	
Steroids use while hospitalized	4 (8%)	9 (16.7%)	0.18
Diuretics use while hospitalized	11 (22%)	13 (24.1%)	0.80
Loperamide use while hospitalized	15 (30%)	14 (25.9%)	0.64
Postoperative ileus	9 (18%)	13 (24.1%)	0.45
Preoperative albumin (g/L) ($\bar{x} \pm SD$)	37.17 ± 5.37	38.37 ± 6.25	0.33
Postoperative albumin (g/L) ($\bar{x} \pm SD$)	32.26 ± 4.94	34.09 ± 4.29	0.05
Length of stay ($\bar{x} \pm SD$)	13.80 ± 8.70	11.59 ± 9.71	0.03
Mean ileostomy output before discharge (ml/day) ($\bar{x} \pm SD$)	675.32 ± 276.18	741.13 ± 346.49	0.29
Serum creatinine at hospital discharge (mg/dL) ($\bar{x} \pm SD$)	0.83 ± 0.77	0.76 ± 0.24	0.56
Glomerular filtration rate at hospital discharge (ml/dak/1.73m^2) ($\bar{x} \pm SD$)	124.14 ± 47.62	106.51 ± 31.71	0.03

Table 3 Readmission variables of patients

	Bundle group $n=50$	Pre-bundle group $n=54$	p
Readmission, any cause	3 (6%)	18 (33.3%)	<0.001
Readmission, dehydration	1 (2%)	12 (22.2%)	0.002
Causes for 30-day readmission			
Dehydration	1	12	
Intraabdominal abscess	2	1	
Ileus/intestinal obstruction	0	1	
GI bleeding	0	1	
Rectovaginal fistula	0	1	
Febrile neutropenia	1	0	
DVT/PTE	0	1	
Poor medical condition	0	1	

High stoma output (> 800 ml/24 h) in the last 3 days before discharge was a significant contributor to dehydration-related rehospitalizations ($p<0.001$). Concurrently, the presence of chronic renal failure (CRF) was associated with a substantial increase in these rates (60% vs 10.1%, $p=0.01$). Other significant predictors included postoperative ileus ($p=0.03$), higher ASA status (III and IV, $p=0.04$), extended hospital stays ($p=0.03$), and small bowel resections, particularly in patients with J-pouches ($p<0.001$). Additionally, a low glomerular filtration rate (GFR ≤ 60) at discharge further heightened the likelihood of hospital readmission due to dehydration ($p=0.02$).

A multivariate logistic regression model was performed that includes all the statistically significant ($p<0.10$) variables determined in univariate analysis. A forward stepwise regression analysis was performed and the final model exhibited a single factor that was found to be associated with readmission due to dehydration was mean ileostomy output before discharge (OR 1.01, CI 1.002–1.02). ROC analysis revealed a strong association between the average stoma output over the last 3 days and readmission due to dehydration, with an area under the curve (AUC) of 0.947 (Fig. 3). The optimal cutoff for this average output was determined

Table 4 Comparative analysis of patient variables and their association with dehydration-related readmission following surgery

	Readmission			
	Dehydration-related readmission *n*, (%)	No dehydration-related readmission *n*, (%)	Total	*p*
Patient groups				
Bundle	1 (2)	49 (98)	50	0.002
Pre-bundle	12 (22.2)	42 (77.8)	54	
BMI ± SD	13 (25.6 ± 4.06)	91 (25.75 ± 4.72)	104	0.99
ASA score ± SD			104	0.74
1	1 (7.7%)	7 (7.7%)		
2	8 (61.5%)	65 (71.4%)		
3	4 (30.8%)	17 (18.7%)		
4	0	2 (2.2%)		
5	0	0		
Diabetes	5 (25.0)	15 (75.0)	20	0.12
Congestive heart failure	0 (0.00)	3 (100.0)	3	1.00
Chronic renal insufficiency	3 (60.0)	2 (40.0)	5	0.01
Preoperative chemotherapy	9 (11.5)	69 (88.5)	78	0.73
Preoperative radiotherapy	3 (7.3)	38 (92.7)	41	0.24
Preoperative use of steroids/immunosuppressant medication	3 (15.0)	17 (85.0)	20	0.71
Smoker	4 (12.9)	27 (87.1)	31	1.00
Weekend discharge	2 (22.2)	7 (77.8)	9	0.31
Preoperative diagnosis				
Rectal cancer	9 (69.2%)	74 (81.3)	83	0.35
Inflammatory bowel disease	2 (15.4)	9 (9.9)	11	
Gynecological cancer	2 (15.4)	8(8.8)	10	
Small bowel resection			104	
None	3 (23.1%)	64 (70.3%)		< 0.001
Resection and anastomosis	5 (38.5%)	23 (25.3%)		
Ileal J pouch-anal anastomosis	5 (38.5%)	4 (4.4%)		
Surgical approach				
Minimally invasive	6 (9.5)	57 (90.5)	63	0.36
Open	7 (17.1)	34 (72.9)	41	
Ileostomy type				
Diverting ileostomy	9 (9.9)	82 (90.1)	91	0.06
End ileostomy	4 (30.8)	9 (69.2)	13	
Clavien-Dindo score				
Grades I–II	5 (6.8)	68 (93.2)	73	0.19
Grades III–IV	8 (25.8)	23 (74.2)	31	
The use of steroids during hospitalization	4 (30.8)	9 (69.2)	13	0.06
The use of diuretics during hospitalization	6 (25.0)	18 (75.0)	24	0.07
The use of loperamide during hospitalization	4 (13.8)	25 (86.2)	29	0.75
Postoperative ileus	6 (27.3)	16 (72.7)	22	0.03
Preoperative albumin (g/L) ± SD	11 (35.50 ± 5.50)	81(38.05 ± 5.81)		0.16
Postoperative albumin (g/L)) ± SD	13 (32.05 ± 4.23)	85 (33.35 ± 4.76)		0.56
Length of stay (days), ± SD	13 (17.92 ± 15.91)	91 (11.90 ± 7.74)		0.14
Mean ileostomy output before discharge (ml/day)	13 (1141 ± 347)	91 (648 ± 258)		< 0.001
Serum creatinine at hospital discharge (mg/dL) ± SD	13 (0.89 ± 0.35)	91 (0.78 ± 0.59)		0.18
Glomerular filtration rate at hospital discharge (ml/min/1.73m^2) ± SD	13 (89 ± 34)	91 (119 ± 41)		0.02

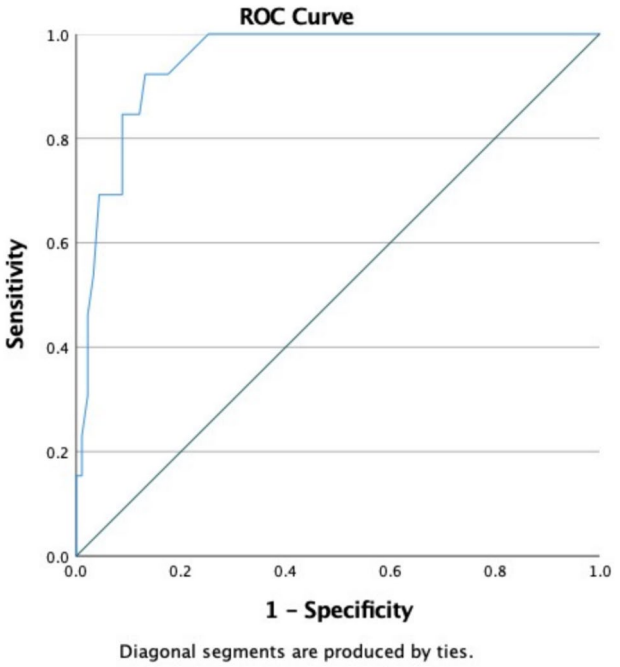


Fig. 3 ROC analysis shows the association between the average stoma output over the last 3 days and readmission due to dehydration

to be 877.5 ml/day, providing a balance between sensitivity (92.3%) and specificity (86.8%), making it a valuable predictor for assessing readmission risk.

Discussion

Our study showed that implementation of PIDBP resulted in a substantially decreased rate of ileostomy-induced dehydration-related complications after colorectal surgery. Our earlier efforts to reduce ileostomy-induced dehydration could not be defined as an "implemented bundle" until March 2021, after which all measures/interventions improved the study outcomes with a greater impact when performed together. A better understanding of the challenges in the clinical care of new ostomates leads to the implementation of more effective and tailored treatment plans. The impetus for implementing this PIDBP stemmed from the understanding that two-thirds of our readmissions were related to dehydration and logistical challenges, including long travel distances during surgical care, constituting an economic burden [18].

As an important indicator of the quality of care, readmissions are under increasing scrutiny due to the substantial impact on healthcare utilization and potentially preventable nature. Given the complexity of physical and psychological adaptations to a new stoma, even in ostomates who are otherwise medically ready for discharge, collaborative and bundled efforts of evidence-based preventive measures, enhanced patient education tools, and optimized post-discharge tracking of ostomates are paramount. This could be the reason why the PIDPB team subconsciously preferred to discharge patients on weekdays instead of weekends in our study in the prospective bundle arm. There was a significant reduction in weekend discharge in the bundle group compared to the pre-bundle group (2% vs 14.8% $p = 0.03$). Like our findings, a number of previous studies suggested that multiple bundle measures are more effective than a single measure for reducing readmission rates following colorectal resections eventuating with a stoma [11, 19, 20].

Readmissions following colorectal surgery may be partially preventable [18, 21] and identifying patients at risk for dehydration-related readmissions is particularly valuable due to their preventable nature. In the current study, several factors were associated with the risk of dehydration-related readmission, such as high stoma output in the last 3 days of the hospitalization (> 800 ml/24 h), chronic renal failure, postoperative ileus, ASA score III and IV status, prolonged hospitalization, small bowel resection, low glomerular filtration rate and diagnoses other than rectal cancer. Regarding the comorbidities, our study showed a significant association between chronic renal failure, but not diabetes, and readmission, as reported in Messaris's study. It has also been reported that the stoma-related complications, including dehydration, fluid, and electrolyte imbalance were higher in patients with lower GFR accounted by the time of ileostomy reversal [3, 20, 22]. This study is consistent with these previous works identifying an apparent tendency to readmit patients with a lower GFR on the day of discharge. Although pre-bundle and bundle patients have different — some of those non-statistically — distribution of some features, such as ileostomy type and GFR rate at hospital discharge that may impact the dehydration-related readmission outcome, the multivariate analysis directly addressing all these patient- and surgery-related variables including some medications (steroid, diuretics, loperamide, etc.) revealed the amount of stoma output in the last 3 days before discharge is independent predictor for readmission. Further analysis revealed a strong association between the average stoma output of 877.5 ml/day over the last 3 days before discharge and readmission with a high sensitivity and specificity rate.

There has long been a discussion regarding the use of loop colostomy as a diversion, mostly due to the potential for dehydration linked to loop ileostomy and the colon's incapacity to function. Nevertheless, according to a meta-analysis conducted by Yang et al. in 2024, loop ileostomy was highly recommended over loop colostomy due to compelling data [23].

An alternative approach that has arisen to avoid the complexities of loop ileostomy is the early closure of the ileostomy. The purpose of the diverting ileostomy

typically ends after the initial postoperative phase, approximately on the 10th day. According to a study conducted by Calderillo-Ruíz et al., early stoma closure is a safe and feasible approach that can be employed to prevent the difficulties associated with ileostomy [24]. Simultaneously, meta-analyses have provided support for the safe and feasible approach to early closure of the ileostomy [25, 26]. Once the possibility of an anastomotic leak after surgery has been eliminated, this method can be considered, particularly for patients who are fragile, in order to reduce the risk of problems related to ileostomy.

In our analysis, we observed a higher rate of preoperative chemotherapy relative to radiotherapy. This disparity primarily stems from our institution's approach to managing proximal rectum tumors, where we favor neoadjuvant chemotherapy without concurrent radiotherapy.

A primary limitation of this study is the modest sample size, which potentially constrains the generalizability of the findings. Notably, the discrepancy between significant factors in univariate analysis and their nonsignificance in multivariate logistic regression may reflect the impact of sample size. Multivariate analysis, being more sensitive to the number of observations, suggests that our study may have lacked the statistical power to detect certain associations when adjusting for multiple variables simultaneously. Therefore, in the context of our small sample size, the results of the multivariate analysis are accepted with caution and considered more indicative of true associations than the univariate analysis.

Another limitation arises from the study's design, which involved comparing a historical control as the pre-bundle group with the prospectively fashioned bundle group. This may have introduced the "Hawthorne effect," where participants' awareness of being observed could lead to more meticulous monitoring, weekdays discharge, and reporting during the bundle period. Moreover, the observed significant reduction in weekend discharges in the bundle group compared to the pre-bundle group suggests a potential discharge bias. This bias likely arises from the PIDPB team's preference for discharging patients on weekdays. Factors contributing to this preference may include greater staff availability, easier access to follow-up care, and a perception of reduced risk associated with weekday discharges. Discharge criteria can be standardized in future studies; to strengthen the evidence, larger multicenter studies are needed. Such studies would likely offer a clearer understanding of the prevention bundle's impact on dehydration and other stoma-related complications, enhancing the reliability and applicability of the findings.

Conclusion

In conclusion, we demonstrated that implementing an exhaustive strategy consisting of educational meetings, comprehensive patient follow-up with telemonitoring to guide ileostomy care, and evidence-based stepwise medical therapy improved readmission outcomes following colorectal resections. The collaborative and enduring efforts among all care providers are crucial for ensuring reduced ileostomy-induced dehydration-related complications, as the major contributor to readmission among ostomates.

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Author contributions Each author's contribution is listed as follows: (1) I. H. Ozata (corresponding author, iozata@ku.edu.tr, Turkey): methodology, conceptualization, investigation, validation, visualization, writing — review and editing, software, formal analysis, project administration, resources, supervision, data curation, writing — original draft; (2) T. Tufekci (ttufekci@ku.edu.tr, Turkey): conceptualization, methodology, formal analysis, writing — original draft, validation, software, data curation; (3) T. Aksan (tukeskin@kuh.ku.edu.tr, Turkey): methodology, data curation, software, resources; (4) E. Eren (eeren@kuh.ku.edu.tr, Turkey): methodology, validation, formal analysis, data curation, resources; (5) S.N. (Karahan skarahan@ku.edu.tr, Turkey): conceptualization, writing — original draft, writing — review and editing, methodology, software, supervision, data curation; (6) M. Kalender (mkalender17@ku.edu.tr, Turkey): writing — original draft, methodology, visualization; (7) Y.B. Gulluoglu (ygulluoglu18@ku.edu.tr, Turkey): writing — original draft, methodology, visualization; (8) D.S. Uymaz (duymaz@ku.edu.tr, Turkey): validation, data curation, visualization; (9) E. Ozoran (eozoran@ku.edu.tr, Turkey): investigation, validation, visualization; (10) A. Karadag (akaradag@ku.edu.tr, Turkey): conceptualization, investigation, writing — review and editing, supervision, project administration, validation; (11) A. Rencuzogullari (arencuzogullari@ku.edu.tr, Turkey): conceptualization, writing — review and editing, supervision, project administration, methodology; (12) D. Bugra (dursunbugra@yahoo.com, Turkey): conceptualization, investigation, writing — review and editing, supervision, project administration; (13) E. Balik (ebalik@ku.edu.tr, Turkey): conceptualization, investigation, writing — review and editing, supervision, validation.

Data availability The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request. Data are located in controlled access data storage at Koc University Hospital.

Declarations

Ethics approval This research paper has been approved by the Ethics Committee at Koc University, attesting to the adherence of this study to ethical standards.

Competing interests The authors declare no competing interests.

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