



ORIGINAL ARTICLE

The impact of prolonged delay to loop ileostomy closure on postoperative morbidity and hospital stay: A retrospective cohort study

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Funding information

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

Abstract

Aim: There is increasing evidence that delayed loop ileostomy closure is associated with an increase in postoperative morbidity. In the context of a publicly funded health service with constrained theatre access, we review the impact of delay in loop ileostomy closure.

Method: A retrospective cohort study of patients undergoing loop ileostomy closure at the Dunedin Public Hospital between 2000–2017 was performed. Cases and complications were identified from the prospectively maintained Otago Clinical Audit database. Patient demographics, ASA score, indications for ileostomy, reasons for delay in closure, length of stay (LOS) after ileostomy closure and complications were collected. LOS and overall complication rate were assessed using univariable and multivariable analyses.

Results: A total of 292 patients were included in the study, of whom 74 (25.3%) were waiting for longer than 12 months for ileostomy closure. The overall complication rate was 21.5%. This was 8% up to 90 days, 20% between 90–360 days, 28% between 360–720 days and 54% after 720 days. Delay was associated with an increased risk of any complication (RR 1.06 for every 30 days with stoma, $p < 0.001$), including Ileus (OR [95% CI] 1.06 [1.00–1.11], $p = 0.024$). Overall mean LOS was 5.9 days (range 1–63), being 4.6 days up to 180 days, 5.6 between 180–720 days and 8.7 after 720 days. LOS significantly increased with increasing stoma duration ($p = 0.04$).

Conclusion: Increasing time with loop ileostomy is detrimental for patients, being associated with an increase in complication rates, and is detrimental for hospitals due to increased length of stay. Resources should be allocated for timely closure of loop ileostomies.

KEYWORDS

length of stay, loop ileostomy, postoperative complications, rectal resection

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INTRODUCTION

Diverting the faecal stream proximal to a low colorectal or ileoanal pouch anastomosis has been shown to reduce the sequelae of an anastomotic leak [1]. As risk of leak increases with the proximity of the anastomosis to the anal verge, the formation of a temporary defunctioning loop ileostomy is routine in many units after the formation of a low anastomosis, although a selective approach may be used [2].

The optimal timing for loop ileostomy closure, and the impact this has on postoperative clinical outcomes, has long been debated. Traditionally, an ideal time has been 3–6 months. Recent interest in early closure, within 2 weeks of index surgery [3], has been supported by a reduction in ileus [4], better tolerance of adjuvant chemotherapy [5], and better bowel function [6,7]. However, patients may also experience a delay in time to closure. We aimed to identify the impact this delay had on surgical outcomes. Retrospective studies comparing closure before and after 6 months have demonstrated an increase in the mean length of stay (LOS) from 5.5 to 9.4 days [8] and an approximate doubling in the average number of complications from 0.33 to 0.61 [8] and in the rate of complications from 17% to 35% [9].

Delay in closure may be contributed to by medical factors, such as comorbidity, adjuvant chemotherapy [9], and by hospital system factors. In a public health system, with limited resources, staged surgery such as ileostomy closure may be given low priority relative to cancer operations, and due to bed and staff shortages caused by the COVID-19 pandemic, resulting in patients frequently waiting longer for closure than intended. In a review of loop ileostomy reversal after rectal cancer surgery in the NHS between 2009 and 2012, 28% of ileostomies were reversed at 6 months and around 60% at 12 months [10]. New Zealand has a similar publicly funded health care system to the NHS, with similar delays in ileostomy closure in our institution. This study documents the impact this has on our patients' postoperative complication rate and LOS, and assesses if the consequences of delay increase with time.

METHODS

This was a retrospective cohort study of patients undergoing reversal of loop ileostomy at Dunedin Public Hospital in New Zealand, between January 2000 and March 2017. Patients were identified from the Otago Clinical Audit [11], an established audit programme which prospectively captures all hospital admissions and surgical operations. Complications are identified by the surgical team shortly after discharge from hospital and are separately signed off by the consultant responsible for the patient's care. Mortality data and readmissions up to 30 days are also identified. Definitions for complications are consistent with those used by the American College of Surgeons National Surgical Quality Improvement Programme and the Centre for Disease Control and Prevention definitions of infection [12,13]. Postoperative ileus was defined as a prolonged time to return of

What does this paper add to the literature?

Despite the recognised consequences of delaying loop ileostomy, this paper demonstrates that patients continue to experience a delay in ileostomy closure, which significantly increases overall complication rates and length of hospital stay. These detrimental changes increase with longer stoma duration.

bowel function, as determined by the surgical team. LOS was defined as the number of days in hospital from the time of surgery, with day 0 being the day of surgery. Patients were included if they received a closure of loop ileostomy after a colorectal or coloanal anastomosis at the time of rectal resection (the index procedure). Patients were excluded if their loop ileostomy was formed to protect an ileal pouch-anal anastomosis or an ileocolic anastomosis. End or double-barrelled ileostomy closures were also excluded. Patient demographics, ASA, the time from index rectal resection to closure of the ileostomy, operative details, LOS following ileostomy closure, and postoperative complications were extracted from the database. Individual clinical records were reviewed to ascertain reasons for delay in ileostomy closure. Primary outcomes assessed were overall complication rate and LOS. Secondary outcomes included mortality, anastomotic leak, ileus/small bowel obstruction, and other complications.

Appropriate summary statistics were used to describe the patient cohort. Differences in reason for delay between 180–360 days and greater than 360 days were compared with Pearson's chi-squared test or Fisher's exact test. Logistic regression was used to model the association between duration with ileostomy and postoperative complications. Sex, age, ASA score, anastomotic leak at the index operation, and delay to ileostomy closure were examined as factors associated with postoperative complications. The same variables, as well as complications after loop ileostomy closure, were included in a quantile regression model for median LOS. Analyses were performed using R (4.1.0) [14] and two-sided $p < 0.05$ was considered statistically significant.

This study was reviewed and approved by the University of Otago Human Ethics Committee (HD21/070).

RESULTS

A total of 292 patients were included in the analysis, baseline demographics are presented in Table 1. There were no patients with missing demographic or complication data. The majority of loop ileostomies were formed during anterior resection performed for malignancy (93.1%). The median duration with stoma was 237 days. A total of 182 patients (62.3%) waited greater than 180 days, 74 (25.3%) patients waited over 360 days and 31 (10.6%) patients waited over 540 days for ileostomy closure.

TABLE 1 Baseline patient demographics and complications after ileostomy closure n (%)

Category	n = 292
Baseline demographics	
Male	178 (61.0%)
Female	114 (39.0%)
Median age in years (range)	68.5 (31–87)
Baseline data and outcomes related to index rectal surgery	
ASA score	
I	54 (18.5%)
II	191 (65.4%)
III	47 (16.1%)
IV	-
Indication for index surgery	
Malignancy	272 (93.1%)
Diverticular disease	16 (5.5%)
Other	4 (1.4%)
Type of closure	
double layer hand-sewn	10 (3.4)
single layer hand-sewn	145 (49.7)
side-to-side double layer hand sewn	4 (1.4)
side-to-side single layer hand sewn	5 (1.7)
stapled	78 (26.7)
unspecified	50 (17.1)
Median time with stoma in weeks (range)	34 (1–203)
Anastomotic leak after index surgery	29 (9.9%)
Complications after closure of Loop Ileostomy	
Patients with any complication	63 (21.5%)
Cardiac	3 (1.0%)
Pulmonary	6 (1.7%)
Renal	3 (0.7%)
Wound infection	14 (4.8%)
Prolonged Ileus	14 (4.8%)
<i>Clostridium difficile</i> diarrhoea	2 (0.7%)
Anastomotic leak	7 (2.4%)
GI Anastomotic bleed	3 (1.0%)
Infection other cause	2 (0.7%)
Death	2 (0.7%)
Other complication	13 (4.5%)

The most common reasons for delay beyond 180 days were hospital factors, chemotherapy, complications related to the index operation, medical co-morbidities, and the development of metastatic disease. In approximately 55% of patients, no reason for delay was identified, or it was directly stated that the delay was due to hospital factors, including limited access to the operating theatres. Factors contributing to the delay that were similar between patients waiting 180–360 days and longer than 360 days (Table 2) were complications related to the index operation and adjuvant chemotherapy. Factors

that were more common in patients waiting more than 360 days included hospital delay, patient comorbidity, metastatic disease, and more than one reason being identified (54% vs. 19%, $p < 0.001$).

The median length of postoperative hospital stay was four days (range 1–63 days). This increased with increasing duration of stoma, being four days for durations up to 180 days, five days for durations between 180 and 720 days, and seven days for durations longer than 720 days (Figure 1a). Patients with a stoma duration over 360 days experienced a wider variation in length of stay, with some patients having a length of stay >20 days. The mean LOS was 5.9 days. When stratified by stoma duration, we found the LOS was 4.6 days up to 180 days with a stoma, 5.6 days between 180 days and 720 days, and 8.7 for stoma duration longer than 720 days.

Complications are presented in Table 1 and Figure 1b. Sixty-three (21.5%) of the 292 patients evaluated experienced one or more complications following ileostomy closure. Wound infection and ileus both occurred in 13 patients (4.5%). The number of complications increased with an increasing duration of stoma, being 8% up to 90 days, 19% between 90–360 days, 27.8% between 360–720 days and 54% after 720 days. There were two deaths in the series, one caused by sepsis due to an anastomotic leak and the other by a myocardial infarction. 175 (60%) of loop ileostomy closures were performed by a colorectal specialist. The median time with a stoma (249 vs. 223 days) and the likelihood of a complication after closure ($p = 0.715$) were similar for those under specialist and nonspecialist care.

The analysis of the risk factors for postoperative complications is summarised in Table 3. Of the investigated predictors of complications, only duration with stoma was statistically significant. From the time of stoma formation, there was a positive association with increasing days with stoma for the risk of any patient developing a complication (RR 1.06, 95% CI [1.02–1.10], $p < 0.001$ per 30 days). In other words, every additional 30 days with stoma increased the risk of having a complication by 6%. There was no evidence of this relationship being nonlinear. Similarly, for prolonged ileus ($n = 14$) for every 30 days with a stoma, the increased odds of an ileus was 6% (OR 1.06, [1.00–1.11], $p = 0.024$). The analysis of variables for length of stay is also summarised in Table 3. In unadjusted models, duration with stoma, older age, ASA II/III and the occurrence of any complication were all significantly associated with greater LOS. In the multifactorial model, the only remaining significant association was a linear increase in median LOS in patients with a complication for each additional 30 days spent with a stoma (Figure 2).

DISCUSSION AND CONCLUSIONS

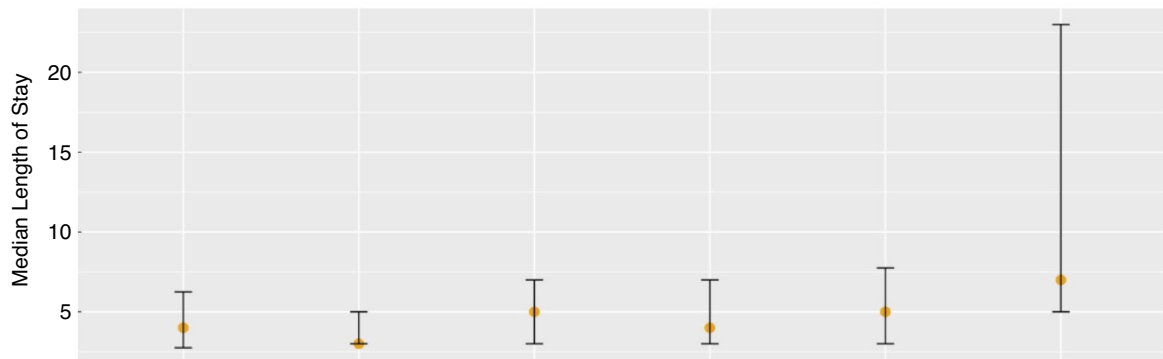
This study demonstrates a significant increase in both overall complications and LOS when loop ileostomy closure is delayed. Complications were identified in 21.5% of patients. Despite sometimes being considered a minor operation, closure of loop

TABLE 2 Identified contributions to ileostomy closure being delayed for six or more months^a

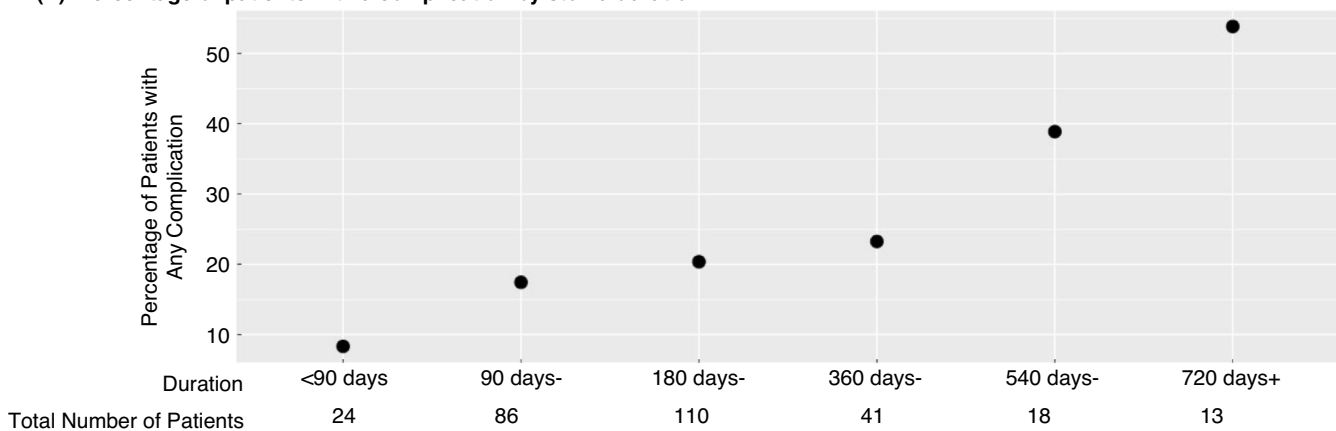
	180–360 days	>360 days	p-value
Number of patients	108	74	
Time to closure median (range)	253.5 (175–360)	520 (372–1426)	
Chemotherapy	36 (33.3)	25 (33.7)	1.0
Complications	22 (20.4)	19 (25.7)	0.51
Anastomotic leak (rectal surgery)	11 (10.2)	10 (13.5)	0.65
Social factors	3 (2.7)	0	0.39
Metastatic disease	4 (3.7)	9 (12.1)	0.04
Patient comorbidities	3 (2.7)	14 (18.1)	<0.001
More than one factor for delay	20 (18.5)	40 (54.1)	<0.001
Hospital delay (implied and/or confirmed)	52 (48.1)	48 (64.9)	0.038

^aValues given as n(%) unless otherwise specified.

(A) Median Length of Stay by duration with a stoma^a



(B) Percentage of patients with a complication by stoma duration



^a Error bars show 25th and 75th Percentiles

FIGURE 1 Median length of stay and percentage of complications according to stoma duration

ileostomy is associated with significant morbidity [15]. The results of a meta-analysis of 6,107 patients [8] support our findings, with an overall complication rate of 17.3%, ileus and wound infection rates of 7.2 and 5%, respectively, and mortality of 0.4%. Our complication rate was strongly associated with the time to ileostomy

closure, approximately doubling with each stepwise increase in delay, when closed up to 90 days, between 90–360 days, between 360–720 days and after 720 days. These results are consistent with studies showing a doubling of the number of complications when comparing closure before and after 6 months [8,9]. An additional

TABLE 3 Effects of variables on postoperative complications and length of stay

		Univariable models			Multivariable model		
Logistic regression analysis for association of factors with postoperative complications							
Variable	Units/level	RR	95% CI	p-value	RR	95% CI	p-value
Age	Per 5 years	1.08	0.94, 1.24	0.287	1.09	0.94, 1.26	0.262
Sex	Male	1.38	0.75, 2.55	0.306	1.33	0.73, 2.42	0.36
ASA	Healthy	Ref		0.556			
	Mild	1.64	0.67, 4.04				
	Severe	1.61	0.55, 4.74				
Anastomotic leak after index surgery	Yes	1.17	0.50, 2.76	0.721			
Days with stoma	Linear per 30 days	1.06	1.02, 1.10	<0.001	1.04	1.02, 1.07	<0.001
Median quantile regression analysis for association of factors with length of hospital stay							
Variable	Units/level	Effect	95% CI	p-value	Effect	95% CI	p-value
Age	Per 5 years	0.20	0.07, 0.42	0.03	0.15	0.04, 0.22	0.08
Sex	Male	-1.0	-1.84, -0.04	0.06	-0.53	-1.29, -0.19	0.18
ASA	1	Ref		0.026	Ref		0.777
	2	2.2	0.41, 4.14		0.53	0.09, 0.96	
	3	3.0	0.58, 5.41		0.21	-0.48, 1.68	
Any Complication	Yes	5	.70, 7.60	<0.001			
Anastomotic leak after index surgery	Yes	1	-0.28, 2.28	0.124			
Days with stoma	Linear per 30 days	0.10	0.04, 0.22	0.04			
	Linear per 30 days with no complications	0	-0.01, 0.1	1	0.01	-0.04, 0.09	0.727
	Linear per 30 days with complications	0.51	0.14, 0.58	0.002	0.51	0.14, 0.59	0.002

Abbreviations: CI, confidence interval; RR, relative risk.

finding in our study was a relative increase in complication risk of 6% for every additional 30-days a patient spends waiting for closure. We are aware of a progressive increase in complications with time being documented in one other study [16]; which noted a “safe” period for ileostomy reversal at 3–6 months and a progressive increase in complications from 9 months onwards. Although increased postoperative *Clostridium difficile* infection with delayed closure is reported by others, *Clostridium difficile* infection is uncommon at our institution, and was not observed with delays in closure. [17]

We found that LOS increased with delay to ileostomy closure. While our overall median length of postoperative hospital stay was 4 days, this increased from 4 days with loop ileostomy duration up to 180 days, to five days between 180 and 720 days and seven days for durations longer than 720 days. This is consistent with an increase in mean LOS from 5.5 to 9.4 days [8], and significantly more patients staying in hospital for longer than 4 days [9], when comparing closure before and after 6 months. The additional

contribution of our study was to document a progressive increase in LOS with increasing delay to stoma closure, and to demonstrate that the progressive increase in the LOS was associated with the parallel increase in complications (Figure 2). In comparison, increasing LOS in patients without a complication was not significant ($p = 0.727$).

There are several plausible explanations for why prolonged delay to ileostomy closure may increase the risk of complication. Diverting the faecal stream alters the gut microbiota [18], resulting in mucosal inflammation and villous and smooth muscle atrophy in the terminal ileum [18,19] and in inflammation of the colonic mucosa [20]. This may contribute to postoperative bacteraemia and ileus. While restoration of continuity has been considered to reverse such changes [20], there is emerging evidence suggesting that occult histological changes and alterations to the enteric nervous system may take much longer to adapt than previously appreciated, with mucosal inflammation [21] and altered bowel function documented as persisting for years after surgery. [7,21,22]

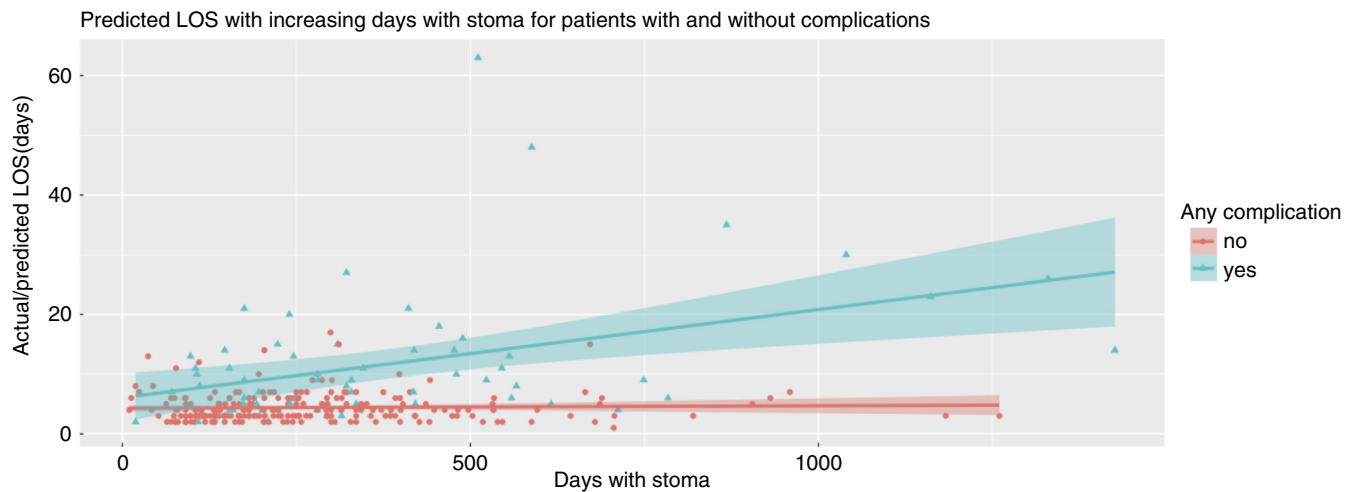


FIGURE 2 Actual and predicted length of stay for days with a stoma in patients with and without complications

These results confirm that delays in ileostomy closure have negative consequences for patients and healthcare systems. We know that even relatively minor postoperative complications worsen patients' quality of life for at least 2 months [23,24], and that increases in complications and LOS add significant visible and hidden health costs, contributing to a greater financial burden on the public health sector. Timely surgery (in approximately 3–6 months) is associated with less frequent complications and a shorter length of stay. This will therefore reduce the cost and improve the cost effectiveness [25] of loop ileostomy closure.

While our study identified a number of associations with delays in ileostomy closure, the main cause was related to hospital system factors, including lack of assigned hospital resources. This was “actively identified” as a contributing factor more frequently in patients waiting greater than 360 days. Identifying this as a cause in 55% of cases is likely to be an underestimation, as retrospectively we were unable to determine what contribution hospital factors had when another reason was identified. Complications at the index operation and chemotherapy were also consistently documented as reasons for a delayed closure. In contrast, the development of metastatic disease, patient comorbidities, more than one contributing cause being identified, and hospital delay were more common causes for delay continuing for more than 12 months. These reasons may also contribute to preventing reversal. A UK study identified adjuvant chemotherapy, no cause identified, surgical complications and medical complications as causes for delayed closure and also identified metastatic disease, anastomotic leak at index operation, and patient refusal as causes for a permanent stoma [9]. Studies consistently show that between 9–26% [26–28] of loop ileostomies become permanent. Reviews in 2016 [10] and 2017 [26] identified risk factors for nonclosure including older age, male sex, increasing ASA score and comorbidity, more advanced cancer, socioeconomic deprivation and anastomotic leakage at the index operation.

Similar to our experience in New Zealand, delay in stoma closure is noted in other public health systems. A review of over 4,800 loop ileostomies formed under England's National Health

Service [10] showed that at 18 months, 27.5% of patients had not had an ileostomy closure. In contrast, in our study, 25% of patients who went on to have their ileostomy closed had not been closed within 12 months. Floodeen et al. [29] found that only 19% of diverting stomas were closed within their target of 4 months and that in 58% of patients the delay was not for any clinical reason, but due to low prioritisation. This is similar to our study, with approximately 55% of cases having no clinical reason or a definite hospital reason identified. As a result of these findings, the Swedish institution now offers a scheduled date for stoma closure prior to discharge from the index operation. Our findings of increased complications, increased LOS after surgery, and the most frequent reason for delay to closure being caused by hospital factors strongly support this approach.

Limitations of our study include this being a retrospective review of a prospectively collected database. This may contribute to our relatively low rates of ileus (4.8%) and wound infection (4.8%). While this is less than reported in some studies, for example a wound infection rate of 6.8% [30] and rates of prolonged ileus or small bowel obstruction of 7%–12% [30–33], our results are similar to that reported in the meta-analysis by Chow [31]. Changes in practice over time may influence our results, although our previous work has not supported this [34] While there was a significant increase in laparoscopic and hybrid anterior resections and the introduction of ERAS, there was no association between approach and complications after loop ileostomy closure, $p = 0.912$. In contrast, there was an increase in delay to closing a stoma of 8.3 days over each year (3.2, 13.5), $p = 0.001$. This was associated with an expected, but due to insufficient power a nonsignificant, increase in complications and LOS.

Further prospectively designed studies should also address complication severity and clinical problems that occur while awaiting for ileostomy closure, such as dehydration and readmission to hospital.

Our study demonstrates that delays to closure of loop ileostomy result in a significant increase in complications and LOS. Hospital resource allocation is the most common cause for delay. For patients in whom diverting loop ileostomy is deemed appropriate, resources should be allocated to ensure these are closed in a timely manner

and avoid unnecessary morbidity. This will result in better patient outcomes, prompt discharge from care, and cost savings for the public health service.

ACKNOWLEDGEMENTS

The authors would like to acknowledge and thank the Otago Clinical Audit staff for their contribution to this manuscript. Open access publishing facilitated by University of Otago, as part of the Wiley - University of Otago agreement via the Council of Australian University Librarians. [Correction added on 23 May 2022, after first online publication : Open Access Funding statement has been added.]

CONFLICT OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

Greg Turner: Conceptualization, methodology, investigation, analysis, writing (original draft and review). Kari Clifford: Writing (original draft and review), data collection, analysis, data curation, data visualisation. Rossi Holloway: data collection, writing draft (review). John Woodfield: Analysis, writing (original draft and review). Mark Thompson-Fawcett: Conceptualization, methodology, investigation, supervision, writing (original draft and review).

ETHICAL APPROVAL

This study was reviewed and approved by the University of Otago Human Ethics Committee (HD21/070).

DATA AVAILABILITY STATEMENT

Anonymised data is available upon reasonable request to the corresponding author.

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How to cite this article: Turner GA, Clifford KA, Holloway R, Woodfield JC, Thompson-Fawcett M. The impact of prolonged delay to loop ileostomy closure on postoperative morbidity and hospital stay: A retrospective cohort study. *Colorectal Dis.* 2022;24:854-861. doi:[10.1111/codi.16095](https://doi.org/10.1111/codi.16095)