Original Article

Trends in Stoma Creation, Complications and Closure in a Tertiary Centre: A Four-Year Retrospective Review

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Abstract

The objective of this study is to examine current trends in intestinal stoma formation, stoma-related complications, hospital readmissions, and reversal outcomes in a tertiary colorectal surgery centre. This retrospective study included all patients undergoing intestinal stoma formation and closure from January 2022 to December 2025. Data on indications, operative approach, complications, readmissions, and reversal outcomes were obtained from the Backup Health Information System (BHIS). Patients with permanent end stomas and those who died before potential reversal were excluded from reversal analysis. A total of 339 patients underwent stoma formation, with an overall increase in annual case volume from 2022, peaking in 2024, followed by a decline in 2025. The most common indications were intestinal obstruction (n = 129, 38.1%), malignancy (n = 82, 24.2%), and diverting stoma for elective surgery (n = 68, 20.1%). Laparoscopic-assisted stoma creation increased from 23.8% to 41.8%. Complications occurred in 77 patients (22.7%), most commonly high-output stoma (n = 30/77, 39.0%), parastomal hernia (n = 14/77, 18.2%) and prolapse (n = 14/77, 18.2%). 55 (71.4%) patients with stoma-related complications were readmitted, most commonly for high-output stoma (28/55, 50.9%), which required multiple readmissions. High-output stoma was more frequent among ileostomies (26/145, 17.9%) than colostomies (4/194, 2.1%), while prolapse was more frequent among colostomies (12/194, 6.2%) than ileostomies (2/145, 1.4%). Among eligible patients, 39.3% (110/280) underwent closure, with a median time of 351 days (range 20–1110 days). Closure was achieved within 6 months in 36/110 patients (32.7%) and within 12 months in 57/110 patients (51.8%). Progressive malignancy was the most common reason for non-reversal (n = 57, 33.5%). These findings highlight the importance of structured stoma care, early identification of complications and systematic follow-up to improve stoma outcomes and facilitate timely reversal where clinically appropriate.

Keywords: Colorectal surgery; colostomy; ileostomy; stoma closure; stoma complications

Introduction

Intestinal stoma formation is an essential component in colorectal surgery. Common indications include colorectal malignancy, intestinal obstruction, perforation, and inflammatory bowel disease (1). In elective surgery, stomas are often created to protect high-risk anastomoses, while in emergency cases they are used to control sepsis or relieve obstruction. Up to 20% of patients undergoing colorectal surgery may require stoma formation (2,3).

Although lifesaving, stomas are associated with significant postoperative morbidity (2). Ileostomies are often complicated by high-output states, dehydration, and electrolyte imbalance, while colostomies more frequently result in parastomal hernia and peristomal skin complications (4). Reported complication rates range from 21% to 70%, with most managed conservatively, though some patients require further surgical intervention (5,6).

Many stomas are intended to be temporary, but reversal rates remain low. Some patients do not proceed to closure because of adjuvant chemotherapy, poor general condition, disease progression, or stoma-related complications (7,8). Approximately 19% of temporary stomas eventually become permanent, particularly in older patients and those with comorbidities (7). Other limiting factors include cancer recurrence, technical surgical difficulty and

anastomotic complications such as leakage or stenosis (9).

While stoma reversal is ideally performed within three months, closure is often delayed to 6 months or longer in reality (10). Delays may be related to postoperative recovery, adjuvant treatment or system-related factors such as long waiting times (11). Prolonged stoma duration increases complication risk and has been associated with poorer functional outcomes following reversal (12,13).

Regional data on trends in stoma formation, complications and reversal remain limited. This study examines four-year trends in intestinal stoma formation at a tertiary colorectal centre, focusing on indications, operative approach, stoma-related complications, readmissions and reversal outcomes to identify areas for improvement in stoma care.

Materials and Methods

This single-centre retrospective cohort study was conducted in the Department of Surgery, Selayang Hospital, Malaysia. All consecutive patients who underwent elective or emergency ileostomy or colostomy formation between 1 January 2022 and 31 December 2025 were included. For the closure analysis, patients with permanent stomas and those who died before potential reversal were excluded, leaving 280 patients in the reversal-eligible cohort. Closure status was assessed up to 30 April 2026. Patients without documented closure by this date were classified as not reversed during the observation period. Patients lost to follow-up were classified as having no documented closure, although their eventual closure status remained unknown. Individual last-contact dates were not consistently available, preventing calculation of actual follow-up duration. These limitations were considered when interpreting the outcomes.

As this audit included all consecutive eligible cases within the predefined four-year study period, no a priori sample size calculation was performed. The cohort comprised 339 unique patients who underwent stoma formation. Each patient was counted once in the patient-level analyses. Inferential analyses were considered exploratory.

Data were obtained from the Backup Health Information System (BHIS) and the stoma-care database. Variables included age, sex, ethnicity, date and indication for stoma formation, operative urgency, type of operation, surgical approach, stoma site and configuration, stoma-related complications and readmissions, date of closure and reason for non-closure.

The primary outcomes were any stoma-related complication and stoma closure among patients eligible for reversal. Secondary outcomes included annual case volume, indications, operative approach, individual complication types, complication-related readmission, time to closure, closure within 6 and 12 months and reasons for non-closure. High-output stoma was defined as output greater than 1,500 mL in 24 hours. Other complications were based on documented clinical or radiological diagnoses. A complication-related readmission was an unplanned admission primarily due to a stoma complication; repeat admissions were recorded separately. Stoma closure was defined as operative restoration of intestinal continuity. Time to closure was calculated from stoma formation to closure. Reasons for non-closure were obtained from the latest documented clinical decision or follow-up status.

Categorical variables were summarised as frequencies and percentages. Continuous variables were reported as mean and standard deviation or median, interquartile range, and range, as appropriate. Categorical variables were compared using Pearson's chi-square test or Fisher's exact test when expected cell counts were small. No multivariable analysis was performed because the study was descriptive and event counts were limited. Associations were therefore unadjusted and exploratory. All tests were two-sided, with $p < 0.05$ considered statistically significant. Analyses were performed using SPSS, version 27 (IBM Corp., Armonk, NY, USA).

Including all consecutive eligible cases reduced selection bias. However, the retrospective design may have resulted in incomplete or misclassified data. The tertiary referral setting may limit generalisability because of its more complex case mix. Potential confounders were not adjusted for, and patients treated later had less time to undergo stoma reversal.

Results

The study included 339 patients with a mean age of 61.19 years and a standard deviation of 14.036. Males accounted for 60.8% (n = 206) of the cohort. Ethnic distribution was 44.2% (n = 150) Chinese, 42.2% (n = 143) Malay, 10.3% (n = 35) Indian and 3.2% (n = 11) from other groups (Table 1).

The most common indications for stoma formation were intestinal obstruction (n = 129, 38.1%), malignancy (n = 82, 24.2%) and elective covering

TABLE 1: Baseline demographic and clinical characteristics of patients (N = 339)

Variable	n (%) / Mean ± SD
Age (years)	61.2 ± 14.0
Male sex	206 (60.8)
Ethnicity	
– Chinese	150 (44.2)
– Malay	143 (42.2)
– Indian	35 (10.3)
– Others	11 (3.2)
Indication for stoma	
– Intestinal obstruction	129 (38.1)
– Malignancy	82 (24.2)
– Elective covering stoma	68 (20.1)
– Others	60 (17.6)
Type of operation	
– Defunctioning colostomy	117 (34.5)
– Anterior resection	79 (23.3)
– Hartmann's procedure	31 (9.1)
– Others	112 (33.1)

SD: Standard deviation

stomas (n = 68, 20.1%), accounting for more than 80% of cases. Less frequent indications included non-traumatic perforation (n = 21, 6.2%), anastomotic leak (n = 13, 3.8%), trauma (n = 10, 2.9%) and gastrointestinal bleeding (n = 9, 2.7%) (Table 1). This reflects the use of bowel diversion in both emergency and elective colorectal surgery and has implications for operative planning and stoma closure (Table 1).

Annual case volume of stoma-related operations shows an increasing trend from 2022 to a peak of 109 cases in 2024, with a slight reduction in 2025 (98 cases). Of 339 stomas, 199 (58.7%) were created in emergency settings and 140 (41.3%) electively. Defunctioning colostomy was the most common procedure (n = 117, 34.5%). Loop stomas constituted the majority, with 211 cases (62.2%), followed by double-barrel stomas in 65 patients (19.2%) and end stomas in 63 patients (18.6%). Colostomies were more frequently performed, accounting for 194 cases (57.2%), while ileostomies comprised 145 cases (42.8%) (Table 2A). Laparotomy remained the most common approach (n = 167, 49.3%), though its proportion declined over time. Laparoscopic-assisted creation increased from 23.8% (n = 10) in 2022 to 41.8% (n = 41) in 2025, while trephine stomas decreased from 21.4% (n = 9) to 14.3% (n = 14) (Table 2B).

Stoma-related complications occurred in 77 of 339 patients (22.7%). The most common complication was high-output stoma (n = 30/77, 39.0%), followed by parastomal hernia and stoma prolapse (n = 14/77 each, 18.2%). Stoma retraction was observed in 6/77 patients (7.8%), and bleeding in 4/77 (5.2%).

TABLE 2A: Surgical characteristics of stoma formation: Distribution of stoma formation

Variable	n (%)
Year of stoma formation	
– 2022	42 (12.4)
– 2023	90 (26.5)
– 2024	109 (32.2)
– 2025	98 (28.9)
Surgical approach	
– Laparotomy	167 (49.3)
– Laparoscopic-assisted	108 (31.9)
– Trephine	64 (18.9)
Surgery urgency	
– Emergency	199 (58.7)
– Elective	140 (41.3)
Stoma site	
– Colostomy	194 (57.2)
– Ileostomy	145 (42.8)
Stoma type	
– Loop	211 (62.2)
– End	63 (18.6)
– Double barrel	65 (19.2)

TABLE 2B: Surgical characteristics of stoma formation: Trends of surgical approach

Surgical Approach	2022	2023	2024	2025
Laparoscopic assisted	10 (23.8)	20 (22.2)	37 (33.9)	41 (41.8)
Laparotomy	23 (54.8)	50 (55.6)	51 (46.8)	43 (43.9)
Trephine	9 (21.4)	20 (22.2)	21 (19.3)	14 (14.3)

Mucocutaneous separation and local sepsis occurred in 3/77 (3.9%) and 2/77 (2.6%) patients, respectively, while rare events such as enterocutaneous fistula, necrosis, stenosis, and stoma oedema, each occurring in 1/77 patients (1.3%) (Table 3A). Annual stoma-related complication rates varied over the study period, occurring in 11 of 42 patients (26.2%) in 2022, 19 of 90 (21.1%) in 2023, 27 of 109 (24.8%) in 2024 and 20 of 98 (20.4%) in 2025 (Table 3B).

Any stoma-related complication occurred in 42/145 ileostomies (29.0%) and 35/194 colostomies (18.0%; p = 0.018). High-output stoma was more frequent among ileostomies (26/145, 17.9%) than colostomies (4/194, 2.1%). Stoma prolapse was more frequent among colostomies (12/194, 6.2%) than ileostomies (2/145, 1.4%), while parastomal hernia occurred in 8/194 colostomies (4.1%) and 6/145 ileostomies (4.1%) (Table 4). Of the 77 patients with stoma-related complications, 55 (71.4%) were readmitted. Readmission was recorded in 28/30 patients with high-output stoma (93.3%), 9/14 with prolapse (64.3%) and 5/14 with parastomal hernia (35.7%). The total number of readmission episodes and the range of episodes per patient were unavailable and are therefore not reported.

TABLE 3A: Stoma-related complications (n = 77): Distribution of stoma-related complications

Complication	n (%)
High-output stoma	30 (39.0)
Parastomal hernia	14 (18.2)
Prolapse	14 (18.2)
Retraction	6 (7.8)
Bleeding	4 (5.2)
Mucocutaneous separation	3 (3.9)
Local sepsis	2 (2.6)
Others	4 (5.2)

Note: Percentages are calculated among the 77 patients who developed complications

TABLE 3B: Stoma-related complications (n = 77): Annual stoma-related complication rates

Year	Complications, n	Total cases, N	Rate (%)
2022	11	42	26.2
2023	19	90	21.1
2024	27	109	24.8
2025	20	98	20.4

Note: Cochran–Armitage test for trend, p = 0.628

TABLE 4: Stoma-related complications by stoma site

Outcome	Colostomy (n = 194), n (%)	Ileostomy (n = 145), n (%)	p-value
Any stoma-related complication	35 (18.0)	42 (29.0)	0.018
High-output stoma	4 (2.1)	26 (17.9)	—
Parastomal hernia	8 (4.1)	6 (4.1)	—
Prolapse	12 (6.2)	2 (1.4)	—
Retraction	4 (2.1)	2 (1.4)	—

The p-value refers to the comparison of any stoma-related complication between ileostomies and colostomies.

Of 280 eligible patients, 110 (39.3%) underwent documented closure by 30 April 2026. The median time to closure was 351 days (range, 20–1,110 days), representing the crude closure proportion during the observation period. Among those closed, 36 patients (32.7%) achieved closure within 6 months and 57 (51.8%) within 12 months (Table 5A).

A total of 60.7% of eligible patients (n = 170) did not undergo stoma closure. The leading cause was progressive malignancy (57/170, 33.5%), followed by loss to follow-up (42/170, 24.7%), ongoing chemotherapy (22/170, 12.9%), and awaiting operation dates (20/170, 11.8%). Other causes included poor general condition or high operative risk (15/170, 8.8%), patient refusal (13/170, 7.6%), and anastomotic issues (1/170, 0.6%) (Table 5B). These findings indicate that both disease-related factors and healthcare system constraints contributed to delayed or absent stoma reversal. Patients lost to follow-up were classified as having no documented closure; however, their eventual closure status remained unknown.
Follow-up continued until 30 April 2026, with no minimum follow-up duration required. A total of 35 patients died before potential stoma reversal, while 42 were lost to follow-up (24.7% of patients who did not undergo closure). Variable follow-up duration and incomplete outcome ascertainment may have influenced the reported complication, readmission and closure rates.

Discussion

This study describes current stoma formation practices, complications, and reversal outcomes in a tertiary Malaysian centre. The predominance of elderly male patients is consistent with colorectal surgery demographics (14). The increase in stoma-related

TABLE 5: Stoma closure outcomes and reasons for non-closure

Outcome	n (%)
A. Stoma closure status (n = 280)	
Stoma reversed	110 (39.3)
Not reversed	170 (60.7)
Reason	**n (%)**
B. Reasons for non-closure (n = 170)	
Progressive malignancy	57 (33.5)
Loss to follow-up	42 (24.7)
Ongoing chemotherapy	22 (12.9)
Awaiting operation date	20 (11.8)
Poor general condition	15 (8.8)
Patient refusal	13 (7.6)
Anastomotic issues	1 (0.6)

procedures reflect both increased referral of complex colorectal cases and the resumption of elective surgical services following the COVID-19 pandemic, a trend also reported by other tertiary centres (1,15).

The majority of stomas in this cohort were created for intestinal obstruction, malignancy, or as elective covering stomas, accounting for more than 80% of cases. This highlights the role of stomas in managing intestinal obstruction and colorectal malignancy in addition to protecting distal anastomoses following elective resections. Similar indications were reported in previous studies (4,16). Stomas were created as either temporary or permanent depending on pathology and surgical intent.

There was increasing use of laparoscopic-assisted stoma creation over the study period. This trend reflects our institutional efforts to reduce stoma-related complications. Open, trephine and laparoscopic approaches are all accepted techniques for stoma formation. However, laparoscopic-assisted stoma creation offers the advantage of direct visualisation of the intra-abdominal cavity, allowing assessment of adhesions and safe adhesiolysis where required. Several studies have shown improved perioperative outcomes with the laparoscopic approach, including reduced blood loss and fewer stoma-related skin complications. Arai et al. demonstrated the safety and efficacy of laparoscopic loop colostomy compared with conventional approaches (17). Wang et al. reported benefits of laparoscopy-assisted ileostomy in obstructed colorectal cancer patients, including reduced surgical trauma and improved recovery (18). Hayashi et al. similarly found that laparoscopic stoma creation was associated with lower intraoperative blood loss and fewer wound-related complications compared with open stoma formation (19).

Stoma-related complications occurred in approximately one-quarter of patients, consistent with rates ranging from 25 to 35% in similar cohorts (5,6). This rate is comparable to that reported by Prakash et al. in emergency laparotomy stomas (20). High-output stoma was the most frequent complication, followed by parastomal hernia and stoma prolapse, which occurred at equal frequencies. Definitions of high-output stoma vary in the literature, with thresholds ranging from ≥1,000 mL to ≥2,000 mL per day (21-23). This variability limits comparison between studies. We defined high-output stoma as an output greater than 1,500 mL per day, consistent with commonly used clinical thresholds (24). High-output stoma was the leading cause of readmission and is associated with dehydration, electrolyte imbalance, and acute kidney injury, particularly in ileostomy patients (25,26). Parastomal hernia remains a common long-term complication following both ileostomy and colostomy formation (3,15). The analysis of factors associated with complications was limited by the retrospective design and incomplete availability of relevant patient- and operative-related variables. The reported associations were unadjusted and should not be interpreted as independent predictors of complications. Residual confounding may therefore have influenced the findings.

Patients with permanent end stomas and those who died before a potential reversal were excluded from reversal analysis to avoid bias and to focus on patients in whom reversal was clinically intended. Among 280 patients eligible for stoma reversal, 110 (39.3%) underwent documented closure during the observation period. The crude closure proportion should be interpreted in the context of variable follow-up duration, as patients undergoing stoma formation later in the study period had less time to proceed to reversal. In addition, eventual closure status was uncertain for patients lost to follow-up. Hsu et al. reported a reversal rate of approximately 90% among non-metastatic rectal cancer patients (9), while Boyer et al. observed reversal in 79% of patients, with a median time to closure of 5.5 months (27). The lower reversal rate observed in this study reflects real-world clinical practice. Factors such as ongoing adjuvant therapy, postoperative complications, comorbidities, and delayed recovery often preclude early reversal. Malignant disease progression was the predominant reason for non-reversal in our study. System-related factors, including prolonged waiting times and loss to follow-up, also contributed, reflecting the challenges

faced by tertiary referral centres managing advanced disease (28).

Delayed stoma reversal in this cohort is likely due to both treatment-related and stoma-specific factors. Ashwath et al. reported that delays in stoma reversal were frequently associated with ongoing adjuvant chemotherapy and postoperative complications (7). Assaf et al. identified high-output stoma as an important complication that can delay recovery and defer safe stoma closure (29). Prolonged stoma duration has been associated with increased healthcare utilisation and reduced quality of life (30). Overall, delayed closure reflects the need to balance oncological status, patient comorbidities, institutional capacity, and readiness for reversal (2,7).

These findings highlight the need for strategies to improve stoma outcomes and support timely reversal where appropriate. This includes more selective stoma formation, structured follow-up, and improved coordination with referring centres. A multidisciplinary approach involving surgeons, stoma care nurses, dietician, pharmacist and physical therapists remains essential (7).

The retrospective design and incomplete documentation of patient- and operative-related variables limited the assessment of factors associated with stoma complications. The analysis described complication rates by stoma site but did not assess independent predictors of complications. Missing data on factors such as frailty, body mass index, nutritional status and surgeon grade also precluded reliable multivariable analysis to identify independent predictors.

Conclusion

This four-year retrospective study describes the patterns of stoma formation, complications, readmissions, and closure in a tertiary Malaysian centre. High-output stoma was an important complication, particularly among patients with ileostomies, and was frequently associated with readmission. Among 280 patients included in the reversal analysis, 110 (39.3%) underwent documented closure during the observation period. Progressive malignancy, loss to follow-up, and ongoing chemotherapy were the leading recorded reasons for non-closure. These findings support structured follow-up, systematic tracking of patients awaiting closure, and coordinated multidisciplinary care. The closure proportion should be interpreted in light of variable observation periods and incomplete outcome ascertainment.

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