

Research Article

Thirty-Day Readmission Following General Surgery: Incidence, Causes and Predictors in a Prospective Cohort

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Abstract: **Introduction:** Unplanned readmission within thirty days of discharge is widely used as an indicator of the quality and safety of surgical care. Readmission after surgery differs fundamentally from readmission after medical admission, being driven predominantly by new complications arising after discharge rather than by deterioration of the condition that prompted the index admission. Prospective data from teaching hospitals in resource-limited settings remain sparse. **Aim:** To determine the incidence, timing, causes and independent predictors of unplanned thirty-day readmission following general surgical procedures. **Materials and Methods:** A prospective observational cohort study was conducted over three years among 500 consecutive patients aged 18 years and above undergoing elective or emergency general surgical procedures and discharged alive. The primary outcome was unplanned readmission to any acute care facility within thirty days of discharge from the index admission; planned readmissions were excluded. Patients were reviewed on the seventh, fifteenth and thirtieth post-discharge days and contacted by telephone where review was not attended. Complications during the index admission were graded by the Clavien-Dindo classification. Data were analysed in SPSS v29 using the chi-square test and multivariable binary logistic regression, with $p < 0.05$ taken as significant. **Results:** Fifty-five of 500 patients were readmitted, an incidence of 11.0%. The median interval to readmission was 8 days, and 38.2% of readmissions occurred within the first post-discharge week. Surgical site infection was the commonest cause (30.9%), followed by ileus or intestinal obstruction (20.0%) and dehydration or electrolyte disturbance (14.5%); 70.9% of readmissions were procedure-related and 80.0% represented problems that had arisen after discharge. Readmission was highest after colorectal resection (17.8%) and lowest after cholecystectomy (5.0%). On multivariable analysis, a complication during the index admission (aOR 3.04), Charlson comorbidity index ≥ 3 (aOR 2.42), stoma creation (aOR 2.38), serum albumin < 3.5 g/dL (aOR 2.21), index stay exceeding 7 days (aOR 2.06), emergency surgery (aOR 1.98) and absence of early post-discharge follow-up (aOR 1.94) were independent predictors. Ten readmitted patients (18.2%) required reoperation and two (3.6%) died. **Conclusion:** Approximately one in nine patients was readmitted within thirty days, most often for a new, procedure-related complication presenting in the first post-discharge week. Because the dominant predictors relate to index complications, nutritional state, stoma care and the availability of early review, readmission is better addressed by structured post-discharge surveillance than by prolonging the index admission.

Keywords: hospital readmission; general surgery; surgical complications; quality of care; surgical site infection; transitional care

INTRODUCTION

Unplanned readmission to hospital shortly after discharge has become one of the most widely adopted indicators of the quality, safety and efficiency of hospital care. Analysis of the United States Medicare programme demonstrated that almost one fifth of beneficiaries were rehospitalised within thirty days of discharge, at very substantial cost, and that a considerable proportion of these episodes appeared potentially avoidable.¹ Findings of this kind prompted the introduction of policies that link hospital reimbursement to risk-adjusted readmission performance, and the metric has since been extended from medical conditions to a widening range of surgical procedures.²

Readmission after surgery is not, however, simply the surgical counterpart of medical readmission, and the distinction has important practical consequences. A

landmark analysis of nationally collected surgical outcome data established that readmissions following operation are overwhelmingly attributable to new complications that develop after the patient has left hospital — most frequently surgical site infection and ileus or obstruction — rather than to exacerbation of the condition that occasioned the index admission or of pre-existing comorbidity.³ Reported readmission rates after general surgical procedures range widely, from about 5% to 15% depending on case mix and the method of ascertainment, and are consistently highest after colorectal and other major gastrointestinal resections.^{4,6,7} The consequences of readmission extend beyond the inconvenience and cost of a further hospital stay. Readmission after colectomy for malignancy has been shown to predict one-year mortality independently of other prognostic factors, indicating that it marks a genuinely vulnerable population rather than merely an

administrative event.⁸ Readmission also generates considerable additional expenditure, much of it borne directly by patients in health systems without comprehensive insurance.⁶

A consistent set of determinants has emerged from the literature. The occurrence of any complication during the index admission is among the strongest and most reproducible predictors, and the risk rises with the number and severity of such complications.^{9,10} Additional recognised factors include a high burden of comorbidity, advanced American Society of Anesthesiologists grade, emergency operation, prolonged index length of stay, hypoalbuminaemia, discharge to a non-home setting and the creation of a stoma, dehydration following ileostomy being a particularly well-documented and largely preventable cause.^{4,11} Composite prediction instruments such as the LACE index and the HOSPITAL score have been derived to stratify this risk at the point of discharge, though their discriminative performance in surgical populations is only moderate.^{12,13}

Two considerations motivate the present study. First, most of the available evidence derives from large administrative datasets and clinical registries in high-income countries; these capture readmission to the index institution reliably but may miss episodes occurring elsewhere, and they seldom describe the post-discharge care pathway in detail.^{5,18} Second, the relationship between early discharge and readmission remains contested, with concern that pressure to shorten the index stay may simply transfer morbidity into the post-discharge period.¹⁴ Prospective, clinically ascertained data from teaching hospitals in resource-limited settings, where post-discharge surveillance and access to primary care differ materially, are correspondingly scarce. This study was therefore undertaken to determine the incidence, timing and causes of unplanned thirty-day readmission after general surgical procedures, and to identify by multivariable analysis the factors independently predictive of its occurrence.

MATERIALS AND METHODS

Study design, setting and duration. This prospective observational cohort study was conducted in the Department of General Surgery of Employees State Insurance Corporation Medical College and Hospital, Kalaburagi, tertiary care teaching hospital over three years. Written informed consent was obtained from every participant.

Participants. Consecutive patients aged 18 years and above undergoing elective or emergency general surgical procedures and discharged alive from the index admission were eligible. Patients who died during the index admission, those who left against medical advice, those undergoing day-care procedures not requiring

overnight stay, and those unable or unwilling to comply with thirty-day follow-up were excluded.

Outcome definition. The primary outcome was unplanned readmission to any acute care facility within thirty days of discharge from the index admission, for any cause. Readmissions that had been arranged in advance — staged procedures, planned stoma reversal, scheduled adjuvant therapy or elective investigation — were classified as planned and excluded from the numerator. Where a patient was readmitted more than once, only the first episode was counted. Secondary outcomes were the interval from discharge to readmission, the principal reason for readmission, the intervention required and mortality during the readmission episode.

Data collection. A structured, pre-tested proforma recorded demographic variables (age, sex), clinical variables (body mass index, comorbidity summarised by the Charlson comorbidity index, diabetes, haemoglobin, serum albumin and ASA physical status grade), operative variables (urgency, procedure performed, operative approach, duration, stoma creation and intra-operative transfusion) and index-admission variables (post-operative complications, length of stay, discharge destination and whether structured discharge counselling with a review appointment within seven days had been arranged). Complications occurring during the index admission were graded using the Clavien-Dindo classification, grade II or above being taken as clinically significant.¹⁹ Surgical site infection was diagnosed using the Centers for Disease Control and Prevention surveillance criteria.²⁰

Follow-up and ascertainment of readmission. Patients were reviewed in the outpatient department on the seventh, fifteenth and thirtieth post-discharge days. Non-attenders were contacted by telephone using a structured questionnaire enquiring specifically about any hospital attendance, admission or procedure since discharge. Where readmission elsewhere was reported, the discharge summary was obtained and the reason verified against source documentation before classification. Patients not contactable after three attempts on separate days were recorded as lost to follow-up and excluded.

Sample size. Using $n = Z^2pq/d^2$, with an anticipated readmission incidence (p) of 11% from previously published general surgical cohorts, $q = 89\%$, absolute precision (d) of 3% and a two-sided 95% confidence level ($Z^2 \approx 3.84$), the required sample was $(3.84 \times 11 \times 89)/(3)^2 \approx 418$. Allowing for loss to follow-up, 500 patients were enrolled.

Statistical analysis. Data were analysed in IBM SPSS Statistics version 29. Categorical variables are expressed as frequencies and percentages, continuous variables as mean $\pm$ standard deviation or median with interquartile range, and readmission incidence with its 95%

confidence interval. Univariable comparisons used the chi-square or Fisher's exact test for categorical variables and the independent-samples t-test or Mann-Whitney U test for continuous variables. Variables attaining $p < 0.10$ were entered into a multivariable binary logistic regression model constructed by backward stepwise elimination, results being reported as adjusted odds ratios with 95% confidence intervals. Model calibration was

assessed by the Hosmer-Lemeshow test and discrimination by the area under the receiver operating characteristic curve. A two-tailed $p < 0.05$ was considered significant.

RESULTS

Five hundred patients were enrolled and completed thirty-day follow-up. Their baseline demographic, clinical and operative characteristics are summarised in Table 1.

Characteristic	Category	n	%
Age (years)	> 65	145	29.0
	≤ 65	355	71.0
Sex	Male	280	56.0
	Female	220	44.0
Charlson comorbidity index	≥ 3	130	26.0
Diabetes mellitus	Present	120	24.0
Serum albumin	< 3.5 g/dL	115	23.0
ASA physical status	Grade III or above	140	28.0
Urgency of operation	Emergency	180	36.0
	Elective	320	64.0
Operative approach	Open	210	42.0
	Laparoscopic	290	58.0
Stoma created	Yes	70	14.0
Intra-operative transfusion	Yes	105	21.0
Complication during index stay	Clavien-Dindo ≥ II	150	30.0
Index length of stay	> 7 days	160	32.0
Discharge destination	Other than home	55	11.0
Review arranged within 7 days	No	165	33.0

Table 1 — Baseline demographic, clinical and operative characteristics of the cohort (n = 500). Mean age 48.7 ± 16.2 years; median index length of stay 6 days (IQR 4–9). ASA = American Society of Anesthesiologists.

The cohort comprised 280 males (56.0%) and 220 females (44.0%) with a mean age of 48.7 ± 16.2 years. Emergency procedures accounted for 36.0% of operations and 42.0% were performed by an open approach. A complication of Clavien-Dindo grade II or above occurred during the index admission in 150 patients (30.0%), and 165 patients (33.0%) were discharged without a review appointment arranged within seven days.

Parameter	n	%
Patients readmitted within 30 days	55	11.0
— within 7 days of discharge	21	38.2 of readmissions
— between 8 and 14 days	18	32.7 of readmissions
— between 15 and 30 days	16	29.1 of readmissions
Readmitted to the index institution	47	85.5 of readmissions
Readmitted to another facility	8	14.5 of readmissions

Table 2 — Incidence and timing of unplanned thirty-day readmission. Median interval from discharge to readmission 8 days (IQR 5–14).

Fifty-five of the 500 patients were readmitted within thirty days, an incidence of **11.0% (95% CI 8.5–14.0)**. Readmission occurred early; the median interval from discharge was 8 days (IQR 5–14) and more than a third of all episodes (38.2%) fell within the first post-discharge week. Eight readmissions (14.5%) occurred at institutions other than the operating hospital and were identified only through structured telephone follow-up, indicating that ascertainment restricted to the index institution would have understated the true rate by approximately one seventh.

Principal reason for readmission	n	%
Surgical site infection	17	30.9
Ileus or intestinal obstruction	11	20.0

Dehydration or electrolyte disturbance	8	14.5
Intra-abdominal collection or abscess	6	10.9
Uncontrolled pain	4	7.3
Anastomotic leak	3	5.5
Cardiopulmonary or other medical cause	3	5.5
Post-operative bleeding	2	3.6
Other	1	1.8
Total	55	100.0

Table 3 — Principal reason for unplanned readmission (n = 55).

Surgical site infection was the single commonest cause, accounting for 17 readmissions (30.9%), followed by ileus or intestinal obstruction (11; 20.0%) and dehydration or electrolyte disturbance (8; 14.5%). Six of the eight dehydration episodes occurred in patients with a newly created stoma. Taken together, procedure-related complications — infection, ileus, collection, anastomotic leak and bleeding — accounted for 39 readmissions (70.9%), while medical causes, pain and dehydration accounted for the remaining 16 (29.1%). Notably, 44 of the 55 readmissions (80.0%) were attributable to problems that had arisen after discharge rather than to the persistence or progression of a problem already evident at the time of discharge.

Procedure category	Operations (n)	Readmitted (n)	Rate (%)
Colorectal resection	90	16	17.8
Small bowel resection / adhesiolysis	45	7	15.6
Hepatobiliary and pancreatic	60	9	15.0
Upper gastrointestinal / gastric	55	8	14.5
Hernia repair	40	3	7.5
Appendicectomy	110	7	6.4
Cholecystectomy	100	5	5.0
Total	500	55	11.0

Table 4 — Readmission rate by procedure category ($\chi^2 = 18.6$, $p = 0.005$).

Readmission varied significantly by procedure ($p = 0.005$). Colorectal resection carried the highest rate at 17.8%, more than three times that following cholecystectomy (5.0%). The four categories involving resection or anastomosis of the gastrointestinal tract — colorectal, small bowel, hepatobiliary-pancreatic and upper gastrointestinal — together comprised 250 operations (50.0% of the cohort) but accounted for 40 of the 55 readmissions (72.7%).

Risk factor	Category	n	Readmitted (%)	n	p-value
Age	> 65 years	145	24 (16.6)		0.010*
	≤ 65 years	355	31 (8.7)		
Sex	Male	280	32 (11.4)		0.732
	Female	220	23 (10.5)		
Charlson index	≥ 3	130	25 (19.2)		< 0.001*
	< 3	370	30 (8.1)		
Diabetes mellitus	Present	120	21 (17.5)		0.008*
	Absent	380	34 (8.9)		
Serum albumin	< 3.5 g/dL	115	22 (19.1)		0.001*
	≥ 3.5 g/dL	385	33 (8.6)		
ASA grade	III or above	140	25 (17.9)		0.002*
	I – II	360	30 (8.3)		
Urgency	Emergency	180	29 (16.1)		0.006*
	Elective	320	26 (8.1)		
Operative approach	Open	210	32 (15.2)		0.009*
	Laparoscopic	290	23 (7.9)		
Index length of stay	> 7 days	160	28 (17.5)		0.002*
	≤ 7 days	340	27 (7.9)		
Index complication	Clavien-Dindo ≥ II	150	31 (20.7)		< 0.001*
	None	350	24 (6.9)		
Stoma	Created	70	15 (21.4)		0.002*
	Not created	430	40 (9.3)		
Transfusion	Received	105	18 (17.1)		0.020*
	Not received	395	37 (9.4)		
Discharge destination	Other than home	55	12 (21.8)		0.006*

	Home	445	43 (9.7)	
Review within 7 days	Not arranged	165	27 (16.4)	0.007*
	Arranged	335	28 (8.4)	
Procedure	Colorectal resection	90	16 (17.8)	0.018*
	All other procedures	410	39 (9.5)	

Table 5 — Univariable analysis of factors associated with thirty-day readmission (chi-square test). * = statistically significant ($p < 0.05$).

Fourteen of the fifteen factors examined were significantly associated with readmission on univariable testing. The strongest associations were with the occurrence of a complication during the index admission (20.7% versus 6.9%; $p < 0.001$) and with a Charlson comorbidity index of 3 or above (19.2% versus 8.1%; $p < 0.001$). Sex was the only variable showing no association ($p = 0.732$). Patients discharged without a review appointment within seven days were readmitted approximately twice as often as those for whom early review had been arranged (16.4% versus 8.4%; $p = 0.007$).

Independent variable	Adjusted OR	95% CI	p-value
Complication during index admission (Clavien-Dindo $\geq$ II)	3.04	1.62 – 5.71	$< 0.001^*$
Charlson comorbidity index ≥ 3	2.42	1.28 – 4.58	0.007*
Stoma creation	2.38	1.16 – 4.88	0.018*
Serum albumin < 3.5 g/dL	2.21	1.15 – 4.25	0.017*
Index length of stay > 7 days	2.06	1.08 – 3.93	0.028*
Emergency surgery	1.98	1.03 – 3.81	0.041*
No review arranged within 7 days of discharge	1.94	1.02 – 3.69	0.043*
ASA grade III or above	1.71	0.88 – 3.32	0.113
Open operative approach	1.62	0.84 – 3.13	0.152
Discharge to other than home	1.58	0.74 – 3.37	0.238
Age > 65 years	1.48	0.77 – 2.85	0.241
Diabetes mellitus	1.44	0.75 – 2.77	0.274
Intra-operative transfusion	1.35	0.68 – 2.68	0.392

Table 6 — Multivariable binary logistic regression identifying independent predictors of thirty-day readmission. Hosmer-Lemeshow $\chi^2 = 7.18$, $p = 0.518$; Nagelkerke $R^2 = 0.27$; area under ROC curve 0.74. * = statistically significant ($p < 0.05$).

Seven variables retained independent significance after adjustment. The occurrence of a complication during the index admission was the dominant predictor, trebling the odds of readmission (aOR 3.04; 95% CI 1.62–5.71), followed by a Charlson index of 3 or above (aOR 2.42) and stoma creation (aOR 2.38). Age, diabetes, ASA grade, operative approach, transfusion and discharge destination lost significance once adjusted, indicating that their univariable effects were mediated largely through comorbidity burden and index complications. The model was well calibrated (Hosmer-Lemeshow $p = 0.518$) and showed acceptable discrimination (area under the curve 0.74).

Outcome of the readmission episode	n	%
Managed conservatively (antibiotics, fluids, nasogastric decompression)	34	61.8
Radiologically guided percutaneous drainage	9	16.4
Reoperation	10	18.2
Death during readmission	2	3.6
Total	55	100.0

Table 7 — Management and outcome of readmission episodes ($n = 55$). Mean duration of readmission stay 6.2 ± 3.4 days.

Most readmissions were managed without further operation: 34 patients (61.8%) required only conservative measures and a further 9 (16.4%) were treated by radiologically guided percutaneous drainage. Ten patients (18.2%) underwent reoperation, most commonly for anastomotic leak or established intra-abdominal sepsis, and two (3.6%) died during the readmission episode. The mean duration of the readmission stay was 6.2 ± 3.4 days, adding appreciably to the total burden of care.

DISCUSSION

The thirty-day readmission incidence of 11.0% observed here corresponds closely with the 11.3% reported in a prospective single-institution general surgical cohort, and lies above the pooled figure of approximately 5.7%

derived from large registry analyses of selected procedures — a difference explained principally by case

mix and by the clinically ascertained, all-facility follow-up used in the present study.^{3,4} The gradient across procedures, with colorectal resection highest at 17.8% and cholecystectomy lowest at 5.0%, likewise

reproduces the pattern consistently documented in the literature.^{6,7}

The distribution of causes carries the most important message. Surgical site infection headed the list, followed by ileus or obstruction, exactly the ranking established in the definitive national analysis of surgical readmission; and, as in that study, the great majority of episodes in this cohort (80.0%) represented *new* problems arising after discharge rather than unresolved problems carried out of hospital.³ This distinction matters, because it implies that readmission after surgery is not primarily a symptom of premature discharge, and that strategies transplanted from medical readmission programmes — which emphasise stabilisation before discharge — are unlikely to be sufficient. The finding that dehydration accounted for 14.5% of readmissions, six of eight episodes occurring in patients with a new stoma, reinforces this interpretation and mirrors evidence identifying dehydration as the leading and largely preventable indication for readmission after ileostomy.¹¹

The occurrence of a complication during the index admission was the strongest independent predictor (aOR 3.04), consistent with large-scale analyses demonstrating a graded relationship between the number and severity of index complications and the probability of subsequent readmission.^{9,10} Comorbidity burden, hypoalbuminaemia, stoma creation and emergency operation likewise retained independence, in accordance with published risk factor syntheses.^{4,7} Prolonged index stay was predictive, whereas early discharge was not associated with excess readmission — an observation concordant with evidence that shorter stay achieved through enhanced recovery pathways does not increase readmission, and with data indicating that prolonged stay is better read as a marker of a complicated course than as a protective intervention.^{14,15}

Perhaps the most actionable finding is that the absence of a review appointment within seven days of discharge independently predicted readmission (aOR 1.94). Systematic reviews of interventions to reduce rehospitalisation have concluded that no single measure is reliably effective, but that bundled transitional-care strategies incorporating early follow-up, structured patient education and telephone contact are the most promising.^{16,17} Given that 38.2% of readmissions here occurred within the first post-discharge week, review scheduled at or before day seven is temporally well placed to intercept the complications that generate them.

Limitations. This was a single-centre study, and its case mix may limit generalisability. Although structured telephone contact captured eight readmissions to other institutions, ascertainment outside the index hospital remains dependent on patient report, a recognised source of misclassification in readmission research.¹⁸ Costs were not measured, longer-term mortality was not followed, and the number of events, while adequate for the model constructed, limited the number of covariates

that could be entered and precluded separate modelling by procedure category.⁵

CONCLUSION

Unplanned readmission within thirty days followed 11.0% of general surgical procedures in this prospective cohort, rising to 17.8% after colorectal resection. Readmission occurred early, at a median of eight days, and was overwhelmingly attributable to new, procedure-related complications arising after discharge — surgical site infection, ileus and dehydration foremost among them — rather than to unresolved problems present at the time of discharge. Seven factors independently predicted readmission: a complication during the index admission, a Charlson comorbidity index of 3 or above, stoma creation, hypoalbuminaemia, prolonged index stay, emergency surgery and the absence of review arranged within seven days. Since the dominant predictors relate to index complications, nutritional state, stoma care and access to early review, the burden of readmission is more likely to be reduced by strengthening post-discharge surveillance — structured stoma and wound education, pre-operative nutritional optimisation and a routine review appointment by the seventh post-discharge day — than by prolonging the index admission. Prospective evaluation of such a transitional-care bundle in this setting is warranted.

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