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Embedding Comprehensive Geriatric Assessment and Shared Decision-Making in the Colorectal Cancer Pathway: Time-to- Discharge Analysis of Length of Stay in Older Adults

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Abstract

Aim

To evaluate a consultant-led joint anaesthesia–geriatrics peri-operative clinic incorporating comprehensive geriatric assessment (CGA) and shared decision-making (SDM) for older adults being considered for colorectal cancer surgery, and to determine which pre-operative variables independently predict postoperative length of stay (LOS).

Methods

Single-centre retrospective cohort of patients aged ≥ 65 years referred to the clinic (2021–2023). Time-to-discharge modelling was performed to evaluate predictors of LOS, including Cox proportional hazards and parametric accelerated failure time (AFT) models. Primary outcomes were LOS, 30- and 90-day mortality and 30-day readmission as well as independent predictors of time to discharge which were examined using Cox proportional hazards and parametric accelerated failure time (AFT) regression models.

Results

Of 197 patients reviewed, 148 underwent major colorectal resection (147 elective, 1 emergency). Median age was 81 years and median LOS was 6 days. Frailty correlated with LOS ($\rho = 0.33$, $p < 0.001$); patients with Clinical Frailty Scale (CFS) ≥ 5 had a median LOS of 13 days. In the Cox model, age (HR 0.94, 95% CI 0.90–0.98), CFS (HR 0.70, 95% CI 0.57–0.88), and comorbidity burden (HR 0.90, 95% CI 0.81–1.00) were associated with lower hazard of discharge. Parametric AFT models were concordant: in the lognormal model, age, CFS, and comorbidity burden were associated with 2.9%, 21.0%, and 6.3% longer time to discharge respectively.

Conclusions

Frailty was the strongest and most consistent independent predictor of prolonged postoperative hospitalisation. Embedding CGA and SDM early in the colorectal cancer pathway may improve peri-operative risk stratification and identify patients likely to require enhanced discharge planning.

Key Findings

Aim: To determine whether frailty and other pre-operative variables independently predict postoperative length of stay in older adults assessed in a consultant-led joint anaesthesia–geriatrics colorectal cancer pathway.

Findings: Among 197 older adults reviewed, 148 underwent major colorectal resection and median postoperative length of stay was 6 days. Frailty was associated with longer stay on unadjusted analysis and remained the strongest and most consistent independent predictor of delayed discharge across Cox and parametric accelerated failure time models.

Message: Frailty should be routinely assessed in older colorectal cancer patients because it provides clinically meaningful information about the risk of prolonged postoperative hospitalisation.

Introduction

The number of operations for colorectal cancer (CRC) in the UK has risen over the past 15 years. Older adults account for a substantial proportion of CRC resections (approximately 65–70% are aged > 65 years), and advancing age is associated with higher postoperative mortality and morbidity, as well as greater risk of complications [1–8]. Frailty is common in this population, with up to 32% of emergency laparotomy patients living with frailty [9, 10].

Despite its importance, frailty assessment is inconsistently applied in emergency and elective surgical pathways. Recent efforts to integrate frailty identification and management into colorectal pathways aim to improve outcomes for older surgical patients [11–13]. The perioperative period provides an opportunity to involve patients and a range of specialists in shared decision-making (SDM).

Comprehensive geriatric assessment (CGA) is an established approach that can optimise patients for surgery, improve survival and reduce complications [14, 15]. While widely used in inpatient care, embedding CGA within outpatient pre-assessment clinics could improve equity and access for those at greatest risk and reduce the need for multiple separate appointments through a single holistic review, as well as potentially improve morbidity and mortality.

Frailty reflects age-related loss of physiological reserve. It can be conceptualised through a phenotype model or deficit-accumulation approach; the Clinical Frailty Scale (CFS) is a judgement-based global frailty measure widely used in UK practice [16]. In the UK, CRC is diagnosed via national lower gastrointestinal cancer screening, two-week-wait referrals or incidentally on imaging. These routes converge in specialist surgical outpatient assessment, yet frailty physician involvement is often missing at this stage. Early inclusion of frailty expertise - standardising clinical frailty score documentation and integrating CGA - may reduce complications and support informed Shared decision-making (SDM).

SDM is particularly relevant in frail populations where operative benefit is finely balanced against risk. Embedding SDM alongside CGA enables explicit alignment between physiological risk, patient priorities, and surgical intent, potentially influencing both treatment selection and downstream outcomes such as length of stay (LOS).

LOS is a critical outcome in colorectal surgery, reflecting both patient recovery and system efficiency. However, LOS is influenced by multiple interacting factors including age, comorbidity, operative

complexity, and frailty. As such, unadjusted associations may be misleading without time-to-event modelling that accounts for the dynamic process of discharge.

The primary outcome was postoperative LOS (days) among patients undergoing major colorectal resection. Secondary outcomes among resection patients were prolonged LOS (defined a priori as LOS > 10 days), 30-day readmission, 30-day accident and emergency (A&E) attendance (any cause) and A&E attendances meeting predefined postoperative-complication criteria, intensive care unit (ICU) admission, and 30- and 90-day mortality. Additional secondary outcomes included the association of surgical approach (laparoscopic, converted, open) with LOS and the association between frailty (CFS) and LOS. In the full cohort, non-operative management after clinic review and reasons for non-operative decisions were described; predictors of non-operative management were analysed where feasible. Given the observational design and absence of a contemporaneous comparator pathway, analyses focus on association rather than causal inference.

Methods

A single-centre retrospective cohort study was conducted at a British district general hospital. Consecutive adults aged ≥ 65 years referred from the colorectal cancer pathway to a joint peri-operative frailty–anaesthesia clinic between 23 September 2021 and 28 December 2023 were included. Patients were followed from clinic assessment through subsequent management and outcomes, with ascertainment to a prespecified censor date (20 May 2024).

Eligible patients were aged ≥ 65 years and referred from colorectal cancer outpatient assessment and/or colorectal cancer multidisciplinary team (MDT) discussion for consideration of colorectal surgery for suspected or confirmed malignancy (benign indications were excluded unless explicitly stated). Patients were included irrespective of eventual management (operative or non-operative). For surgery-specific analyses, major colorectal resections were included and transanal endoscopic microsurgery (TEMS) and abandoned procedures were excluded. Of 197 patients, surgical outcomes were analysed in 148 patients (147 elective, 1 emergency). Two TEMS and one abandoned case were excluded from surgery-specific analyses; non-operative patients (n = 46) were characterised separately.

For each patient, demographics; Clinical Frailty Scale (CFS); comorbidities and mobility; living situation and package-of-care (POC) status; number of regular medications; tumour site and Union for International Cancer Control (UICC) tumour-node-metastasis (TNM) stage; surgical intent, procedure and approach; physiological risk (Portsmouth Physiological and Operative Severity Score for the Enumeration of Mortality and Morbidity [P-POSSUM], National Surgical Quality Improvement Program [NSQIP]); postoperative length of stay (LOS); 30- and 90-day mortality; and 30-day readmission were recorded. CFS was extrapolated from clinic notes. Follow-up and unplanned attendances were ascertained across Trust systems to 20 May 2024. The following inclusion criteria were used for A&E attendance due to postoperative complications:

- Wound infection

- Wound dehiscence
- Deep vein thrombosis (DVT)/pulmonary embolus (PE) within 28 days of operation and related symptoms
- Sepsis with intra-abdominal/wound-site sources
- Pain related to wound sites
- Per rectum (PR) bleeding

Data were abstracted from paper and electronic records (clinic letters, MDT outcomes, discharge summaries, operation notes and Picture archiving and communication system (PACS)) using a prespecified data dictionary and standardised extraction template by two investigators. A subset of records underwent secondary verification for key fields (CFS, procedure type/approach, LOS, readmission and mortality), with discrepancies resolved by consensus using source documentation.

Mobility was insufficiently documented for 15 patients.

Analysis

Statistical analysis was performed on Anaconda Navigator (Anaconda, Inc., Austin, TX, USA) and Jupyter (Project Jupyter, CA, USA) using Python 3.9 (Python Software Foundation, Virginia, USA) as the programming language, along with their extensions. Associations between LOS and ordinal or non-normally distributed variables (including CFS) were assessed using Spearman's rank correlation. To evaluate time to discharge in an adjusted framework, a Cox proportional hazards model was constructed with discharge as the event of interest. Hazard ratios (HR) below 1 were interpreted as reduced likelihood of discharge at any given time and therefore prolonged hospital stay.

To test the robustness of findings, parametric accelerated failure time (AFT) models using lognormal and Weibull distributions were also fitted. Results from these models are presented as acceleration time ratios (ATR), with ATR > 1 indicating longer time to discharge. Covariates entered into the time-to-discharge models included age, CFS, comorbidity burden, physiological risk, and procedure category. Complete-case analysis was used for modelling. Procedure category was entered as a categorical variable with the reference category defined in the statistical output. Model assumptions, including the proportional hazards assumption for the Cox model, were assessed prior to interpretation.

Model assumptions were assessed, and results were interpreted as associations rather than causal effects given the observational design. Graphs were produced via Matplotlib (Python). A p value < 0.05 was considered significant.

Results

Baseline patient characteristics

Over 28 months (23 September 2021–28 December 2023), 197 patients were assessed; 147 (74.6%) proceeded to elective major resection. Clinic activity increased toward late-2023 (approximately 4.6-fold from 2021 to 2022 and 1.8-fold from 2022 to 2023). The median follow-up time from clinic date was 431 days (14.2 months), with a range from 144 days (4.7 months) to 970 days (31.2 months). This calculation includes 197 patients with valid clinic dates.

The median age at clinic review was 81 years; the median CFS was 4 (IQR 3–4). Patients had a median of five comorbidities, most commonly hypertension, type 2 diabetes, osteoarthritis and atrial fibrillation.

The median number of regular medications was 4 (range 0–17). Most patients were independently mobile (61.3%); 20.6% used sticks and 5.1% used frames. The majority lived at home (91.4%); 1.5% lived in sheltered accommodation. ADL independence was common (74.7%), with 14.1% requiring assistance with personal care and 5.1% receiving regular care (once to four times daily POC).

All patients had UICC TNM staging. The most frequent primary site was caecum (21.2%) followed by rectum (18.2%). Most common TNM stage at diagnosis was T3N0M0. Most had no nodal disease (n = 101); distant metastases were present in 12 patients.

Figure 1 *Distribution of hospital length of stay by Clinical Frailty Scale (CFS). Each box represents the interquartile range (IQR), the horizontal lines indicate the median, whiskers extend to 1.5×IQR, and circles denote outliers*

Surgical Outcomes

Overall, 148 major resections were performed: 147 (99.3%) elective and 1 (0.7%) emergency. Two patients were instead treated with transanal endoscopic microsurgery (TEMS) and one procedure was abandoned in favour of neoadjuvant therapy.

Elective procedures included hemicolectomy (50.3%; right n = 67, left n = 7), anterior resection (17.6%) and abdominoperineal resection (APR) (5.4%) among others. (Fig. 1). The median interval from MDT to CGA clinic was 14 days.

Figure 2 *Frequency of major colorectal surgical procedures*

Laparoscopy was used in 79.2% of cases (n = 118); 10.7% (n = 16) were converted; 8.1% (n = 12) were primary open laparotomies; and there was one Altemeier procedure. The median postoperative LOS for elective surgery was 6.0 days (IQR 5–11; range 0–86). Among hemicolectomy patients (n = 74), median LOS was 9.5 days; for anterior resection (n = 24), 7.4 days. Median LOS was shorter in laparoscopic vs converted and open procedures (6.0 vs 8.0 vs 13 days) (Table 1).

Table 1. Length of stay by surgical approach. LOS, length of stay.

Approach	Count	Mean (LOS)	Median (LOS)
Laparoscopic	118	8.0 ± 6.6	6.0
Converted	16	14.9 ± 19.6	8.0
Open	12	16.6 ± 11.7	13.0

Thirty-day readmission was 12.8% (n = 19). There were no deaths at 30 or 90 days. Median P-POSSUM mortality risk was 2.5% and NSQIP 2.9%.

Non-operative management

A total of 46 patients (23.4%) were managed without elective surgery (excluding TEMS, neoadjuvant and emergency cases). Reasons for nonsurgical outcomes included patient preference (34.0%), high operative risk (27.7%), death prior to surgery (21.7%) and palliative care (15.2%). Overall, 56.5% of non-operative decisions involved patient choice (with or without high risk); medical contraindications alone accounted for the remainder.

Compared with surgical patients, non-operative patients were older and frailer: median CFS 5.0 versus 3.0 in the surgical group ($p < 0.001$). Chronic obstructive pulmonary disease (COPD) was more prevalent in the non-operative group (26.1% vs 10.2%, $p = 0.013$). Non-surgical patients had a higher comorbidity burden (mean number of comorbidities 5.7 ± 2.4 vs 4.7 ± 2.2; $p = 0.014$). Those with > 5 comorbidities comprised 55% of the non-surgical group vs 35% of the surgical group (Table 2; Fig. 3).

Table 2. *Characteristics of surgical and non-operative patients. CFS, Clinical Frailty Scale; TNM, tumour-node-metastasis.*

Characteristic	Surgical (n = 147)	Non-operative (n = 46)	Total (n = 197)
Age, years			
Median (range)	80 (65–92)	84 (66–94)	81 (65–94)
**Primary diagnosis, n (%)*			
Caecal carcinoma	31 (21.1%)	11 (23.9%)	42 (21.2%)
Rectal carcinoma	26 (17.7%)	10 (21.7%)	36 (18.2%)
Ascending colon carcinoma	19 (12.9%)	4 (8.7%)	23 (11.7%)
Clinical Frailty Scale (CFS)			
Median (IQR)	3 (3–4)	5 (4–5)	4 (3–4)
Number of comorbidities			
Median (range)	4 (0–12)	6 (0–10)	5 (0–12)
0	9 (6.1%)	7 (15.2%)	16 (8.1%)
1–2	15 (10.2%)	3 (6.5%)	18 (9.1%)
3–4	50 (34.0%)	10 (21.7%)	60 (30.5%)
≥5	73 (49.7%)	26 (56.5%)	99 (50.3%)
Number of regular medications			
Median (range)	5 (0–15)	4 (0–17)	4 (0–17)
0	12 (8.2%)	13 (28.3%)	25 (12.7%)
1–4	61 (41.5%)	15 (32.6%)	76 (38.6%)
≥5	74 (50.3%)	18 (39.1%)	92 (46.7%)
TNM stage at diagnosis			
T1	6 (4.1%)	1 (2.2%)	7 (3.6%)
T2	23 (15.6%)	8 (17.4%)	31 (15.7%)
T3	80 (54.4%)	13 (28.3%)	93 (47.2%)
T4	9 (6.1%)	8 (17.4%)	17 (8.6%)
N0	75 (51.0%)	26 (56.5%)	101 (51.3%)
N1–2	72 (49.0%)	20 (43.5%)	92 (46.7%)
M0	119 (81.0%)	36 (78.3%)	155 (78.7%)

M1	8 (5.4%)	3 (6.5%)	11 (5.6%)
Surgical procedure (surgical patients only)			
Hemicolectomy	74 (50.3%)	—	—
Anterior resection	26 (17.6%)	—	—
Abdominoperineal resection	8 (5.4%)	—	—
Other / combined procedures	39 (26.5%)	—	—

Figure 3 *Clinical frailty and disease comorbidity between surgical and non-surgical patients. Whisker bars are 1.5xIQR, solid line = median*

A&E and ICU admissions

The 30-day A&E attendance rate was 18%. Within 30 days, 6.7% of patients had an attendance meeting our predefined postoperative-complication criteria (vs 29% in a published comparator series [18]). Among octogenarians, no patients required ICU admission (vs 4.9% reported in a comparator cohort [18]).

Length of Stay: Multivariable and Time-to-Discharge Analysis

Unadjusted analyses demonstrated a correlation between frailty and LOS (Spearman's $\rho = 0.33$, $p < 0.001$). However, given the multiple potential confounders influencing LOS, multivariable modelling was performed. Median LOS by CFS category was: CFS 2: 5.5 days; CFS 3–4: 6.0 days; CFS 5: 13.0 days; CFS 6: 11.0 days.

In the Cox proportional hazards model, increasing age was associated with a lower hazard of discharge (HR 0.94, 95% CI 0.90–0.98; $p = 0.002$). Frailty showed a stronger association, with each one-point increase in CFS associated with a 29.5% reduction in the hazard of discharge (HR 0.70, 95% CI 0.57–0.88; $p = 0.0019$). Greater comorbidity burden was also associated with reduced discharge rate (HR 0.90, 95% CI 0.81–1.00; $p = 0.044$). Physiological risk was not significantly associated with time to discharge (HR 0.98, 95% CI 0.94–1.03; $p = 0.473$) (Fig. 4) (Supplemental Table S1).

Figure 4 *Adjusted Cox proportional hazards model for time to hospital discharge after colorectal resection. Forest plot showing hazard ratios (HRs) and 95% confidence intervals for age (years), Clinical Frailty Scale (CFS) score, comorbidity burden (number of recorded comorbid conditions), physiological risk (pre-operative risk estimate derived from operative risk scoring), and procedure category (categorised operative type, with comparator category defined by the model reference group). HRs below 1 indicate a lower hazard of discharge at any given time and therefore longer hospitalisation. Increasing age, higher frailty, and greater comorbidity burden were associated with reduced discharge rate.*

Parametric AFT models were concordant. In the lognormal model, each additional year of age was associated with a 2.9% longer time to discharge (ATR 1.029, 95% CI 1.010–1.049; p = 0.0027), each one-point increase in CFS with a 21.0% longer time to discharge (ATR 1.210, 95% CI 1.086–1.349; p = 0.0006), and each additional comorbidity with a 6.3% longer time to discharge (ATR 1.063, 95% CI 1.010–1.118; p = 0.018) (Fig. 5) (Supplemental Table S2).

Figure 5 *Adjusted lognormal accelerated failure time model for time to hospital discharge after colorectal resection. Forest plot showing acceleration time ratios (ATRs) and 95% confidence intervals for age (years), Clinical Frailty Scale (CFS) score, comorbidity burden (number of recorded comorbid conditions), and procedure category (categorised operative type, with comparator category defined by the model reference group). ATRs above 1 indicate longer time to discharge. Increasing age, higher frailty, and greater comorbidity burden were associated with prolonged hospitalisation.*

The Weibull AFT model demonstrated similar findings: age ATR 1.035 (95% CI 1.009–1.061; p = 0.0069), CFS ATR 1.346 (95% CI 1.175–1.543; p < 0.001), and comorbidity burden ATR 1.091 (95% CI 1.018–1.169; p = 0.013). Across all adjusted time-to-discharge models, frailty emerged as the strongest and most consistent predictor of prolonged hospitalisation (Fig. 6) (Supplemental Table S3).

Figure 6 *Adjusted Weibull accelerated failure time model for time to hospital discharge after colorectal resection. Forest plot showing acceleration time ratios (ATRs) and 95% confidence intervals for age (years), Clinical Frailty Scale (CFS) score, comorbidity burden (number of recorded comorbid conditions), and procedure category (categorised operative type, with comparator category defined by the model reference group). ATRs above 1 indicate longer time to discharge. Findings were concordant with the lognormal model, with frailty emerging as the strongest and most consistent predictor of prolonged hospitalisation.*

Compared to published literature, median LOS in this cohort (6 days) was shorter than national averages (7 days) [19]. This contextual comparison is descriptive only and should not be interpreted as evidence that the clinic caused shorter LOS. The comparison with historical institutional data before clinic implementation has been omitted here because it is not formally described within the present study methods.

Previous studies without structured peri-operative frailty assessment report longer LOS, particularly in frail populations, and the present findings are compatible with the hypothesis that earlier CGA and SDM may support more informed peri-operative planning and discharge preparation.

Discussion

This single-centre evaluation demonstrates that a joint geriatric–anaesthetic pre-assessment SDM clinic with embedded CGA for older adults living with frailty and scheduled for CRC surgery is feasible and associated with favourable outcomes. Among 147 elective surgical patients (median age 81 years; substantial frailty burden), we observed 0% 30- and 90-day mortality - numerically lower than recent national audit estimates—and a median LOS of 6 days, shorter than the 7-day national average and

durations reported in retrospective series [1, 19, 20], despite approximately half of the cohort having CFS ≥ 4.Frailty was associated with prolonged stay: median LOS 13 days for CFS ≥ 5 versus 6 days for CFS < 5, with a markedly higher LOS > 10 days in the frailest group. Readmissions at 30 days (12.8%) compared favourably with UK estimates (15–29%) [21, 22]. A substantial proportion of patients were also managed non-operatively after clinic review, and these patients were older, frailer, and more multimorbid than those proceeding to surgery.

The time-to-discharge models strengthen these findings by showing that the observed frailty effect is not simply descriptive but persists in an adjusted framework. In the Cox model, frailty, age, and comorbidity burden were each associated with reduced likelihood of discharge at any given time point, indicating prolonged recovery. The concordance of the lognormal and Weibull AFT models further supports the robustness of this association and provides an intuitive interpretation in terms of prolonged time to discharge. Frailty showed the largest and most consistent effect size across these adjusted models.

These findings reinforce literature linking frailty to adverse postoperative outcomes and longer LOS in CRC surgery [23, 24] and highlight persistent under-use of CGA in peri-operative pathways [25]. Consistent with the Centre for Perioperative Care (CPOC) guidance and the American Society of Colon and Rectal Surgeons recommendations, our service emphasised physiological age over chronology and operationalised SDM with CGA within 14 days of MDT referral - an approach seldom described in detail [17, 26]. Importantly, SDM in this context is not merely an ethical ideal but an operational component of peri-operative care, helping align treatment intensity with patient goals, quantify acceptable trade-offs, and shape whether surgery proceeds at all. The sizeable non-operative group supports the relevance of this integrated clinic model where the balance of operative risk and benefit is narrow.

This study draws on real-world, whole-pathway data with follow-up extending to 32 months. However, interpretation is constrained by its single-centre design, the absence of a contemporaneous control group, and incomplete documentation in a small minority of records (for example, procedure laterality and surgical approach).

Further limitations are important. First, the cohort was derived from patients referred to a joint frailty–anaesthesia clinic rather than all older adults on the colorectal cancer pathway, introducing potential referral and selection bias. Patients perceived to be frailer or more complex may have been preferentially referred, while fitter patients may have progressed through standard pathways. Second, LOS is an important but imperfect endpoint, reflecting not only physiological recovery but also organisational factors such as discharge logistics, social care availability, rehabilitation access, and weekend discharge patterns. Third, although age, frailty, comorbidity burden, physiological risk, and procedure category were included in the adjusted models, residual confounding remains possible, including from variables such as nutritional status, sarcopenia, postoperative complication severity, and enhanced recovery adherence.

Despite these limitations, several features support the reliability of the modelling. The direction of effect was stable across the Cox, lognormal, and Weibull approaches; the effect estimates for age, frailty, and comorbidity were clinically plausible; and frailty remained the strongest and most consistent signal

across models. The principal contribution of this study is therefore not to prove that the clinic caused shorter LOS, but to show that within a real-world peri-operative frailty pathway, frailty and multimorbidity meaningfully stratify postoperative hospitalisation. Future research should comprise multicentre, cluster-randomised evaluations that compare standard pre-assessment with integrated CGA–SDM clinics and should embed formal cost-utility analysis alongside patient-reported outcome measures.

Implications

The implications of this study relate primarily to pathway design and peri-operative risk stratification. Routine frailty documentation using a standardised measure such as CFS appears justified within the colorectal cancer pathway because frailty was consistently associated with longer hospital stay across both unadjusted and adjusted analyses. Integrating CGA and SDM upstream of surgery provides a structured opportunity to identify patients at risk of delayed discharge, support counselling about expected recovery trajectory, and align operative decision-making with physiological reserve rather than chronological age alone.

The findings also suggest that frailty should be treated not merely as a background descriptor but as an operational variable relevant to bed planning, discharge planning, and selection for enhanced multidisciplinary input. Finally, the sizeable proportion of patients managed non-operatively after clinic review supports the role of integrated frailty assessment in refining treatment selection where operative risk and benefit are closely balanced.

Conclusion

Embedding a consultant-led CGA and SDM clinic upstream in the CRC pathway appears feasible and clinically relevant for older patients being considered for colorectal cancer surgery. In this cohort, the service was associated with zero 30- and 90-day mortality, a median LOS of six days, and readmission rates that compare favourably with published series. Adjusted time-to-discharge modelling demonstrated that increasing frailty, age, and comorbidity burden were associated with prolonged hospitalisation, with frailty emerging as the strongest and most consistent predictor across models. Of the variables assessed, the CFS performed as the most informative and clinically useful predictor of prolonged admission, supporting its routine incorporation into pre-operative colorectal assessment pathways. While the single-centre retrospective design precludes causal inference, the internal consistency of the modelling supports the conclusion that frailty is a clinically important determinant of postoperative admission duration. Ongoing work is focused on developing a pre-operative clinic calculator to estimate postoperative length of stay using routinely available clinical variables, with the aim of improving counselling, discharge planning, and peri-operative resource allocation. Wider adoption and prospective multicentre validation are recommended.

Declarations

Ethics approval and consent to participate

Institutional approval was granted for this retrospective study by the relevant local governance body at the participating tertiary neurosurgical centre. The study was conducted in accordance with local institutional standards and the principles of the Declaration of Helsinki. Because the study used retrospectively collected, de-identified clinical data, individual patient consent to participate was waived.

Consent for publication

Consent for publication was not required because this study used retrospectively collected, fully anonymised data and does not contain any identifiable individual patient information.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

BR, CP, DA, JJ and MK wrote the manuscript and edited it for submission. BR, CP and DA prepared the figures. BR, ES, JJ and MK were involved in the whole conception and methodology. Statistical analysis was done by BR, CP and DA. JJ, ES and MK supervised the project. All authors reviewed the manuscript. DA, CP, BR and HG were involved in data collection and processing.

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Availability of data and material

The datasets generated and/or analysed during the current study are not publicly available because they contain patient-level clinical data and are subject to institutional data-governance restrictions. De-identified data may be made available from the corresponding author on reasonable request, subject to institutional approval and applicable data-sharing agreements.

Data availability

Data supporting the findings are available from the corresponding author upon reasonable request.

References

1. National Bowel Cancer Audit. *State of the Nation Report 2025: an audit of care received by people diagnosed or undergoing surgery for bowel cancer in England and Wales* (National Cancer Audit Collaborating Centre, Royal College of Surgeons of England, 2025).
2. Soler-González, G. et al. Update on the management of elderly patients with colorectal cancer. *Clin. Transl. Oncol.* **26** (1), 69–84 (2024).
3. Normann, M., Ekerstad, N., Angenete, E. & Prytz, M. Mortality and morbidity after colorectal cancer resection surgery in elderly patients: a retrospective population-based study in Sweden. *World J. Surg. Oncol.* **22** (1), 23 (2024).
4. Navarra, A. et al. Long-term outcomes in elderly patients after elective surgery for colorectal cancer within an ERAS protocol: a retrospective analysis. *Langenbecks Arch. Surg.* **408** (1), 438 (2023).
5. Azher, H. et al. Are health outcomes in the older colorectal cancer patients treated by curative intent surgery any different to the younger patients? *ANZ J. Surg.* **93** (5), 1185–1189 (2023).
6. Niemeläinen, S. et al. Clinical Frailty Scale predicts overall survival after colon cancer surgery in people aged 80 years and older: A prospective multicentre observational study. *Colorectal Dis.* **27** (8), e70190 (2025).
7. Artiles-Armas, M. et al. Impact of frailty on 5-year survival in patients older than 70 years undergoing colorectal surgery for cancer. *World J. Surg. Oncol.* **19** (1), 106 (2021).
8. Richards, S. J. G., Cherry, T. J., Frizelle, F. A. & Eglinton, T. W. Pre-operative frailty is predictive of adverse post-operative outcomes in colorectal cancer patients. *ANZ J. Surg.* **91** (3), 379–386 (2021).
9. Millan, M. et al. Treatment of colorectal cancer in the elderly. *World J. Gastrointest. Oncol.* **7** (10), 204–220 (2015).
10. Park, B. et al. Frailty using the Clinical Frailty Scale to predict short- and long-term adverse outcomes following emergency laparotomy: meta-analysis. *BJS Open.* ;**8**(4). (2024).
11. Skořepa, P. et al. The impact of prehabilitation on outcomes in frail and high-risk patients undergoing major abdominal surgery: A systematic review and meta-analysis. *Clin. Nutr.* **43** (3), 629–648 (2024).
12. Staiger, R. D. et al. Surgical outcome improvement by shared decision-making: value of a preoperative multidisciplinary target clinic for the elderly in colorectal surgery. *Langenbecks Arch. Surg.* **408** (1), 316 (2023).
13. Rostoft, S. & Hamaker, M. E. Basic geriatric principles for colorectal surgeons: How to optimize assessment and care of older patients in the perioperative period. *Eur. J. Surg. Oncol.* **46** (3), 310–315 (2020).

14. Ketelaers, S. et al. The influence of geriatric screening and evaluation on the treatment decisions and postoperative outcomes in vulnerable elderly colorectal cancer patients. *Eur. J. Surg. Oncol.* **49**, e24–e5 (2023).
15. Suzuki, Y. et al. Effectiveness of frailty screening and perioperative team management of colectomy patients aged 80 years or more. *Am. J. Surg.* **223** (2), 346–352 (2022).
16. Turner, G. & Clegg, A. Best practice guidelines for the management of frailty: a British Geriatrics Society, Age UK and Royal College of General Practitioners report. *Age Ageing*. **43** (6), 744–747 (2014).
17. Partridge, J. S. L., Ryan, J. & Dhesi, J. K. New guidelines for the perioperative care of people living with frailty undergoing elective and emergency surgery-a commentary. *Age Ageing* ;**51**(11). (2022).
18. Thungathurthi, K. et al. Outcomes in octogenarians following elective colorectal cancer surgery. *J. Gastrointest. Oncol.* **14** (4), 1726–1734 (2023).
19. UK Colorectal Cancer Intelligence Hub. *University of Leeds. Length of hospital stay after major surgical resection for colorectal cancer. Data briefing* (University of Leeds, 2019).
20. Aravani, A. et al. A retrospective observational study of length of stay in hospital after colorectal cancer surgery in England (1998–2010). *Med. (Baltim).* **95** (47), e5064 (2016).
21. Xu, W. et al. Characterising nationwide reasons for unplanned hospital readmission after colorectal cancer surgery. *Colorectal disease: official J. Association Coloproctology Great Br. Irel.* ;**25**. (2023).
22. D'Souza, J., Richards, S., Eglinton, T. & Frizelle, F. Incidence and risk factors for unplanned readmission after colorectal surgery: A meta-analysis. *PLoS One*. **18** (11), e0293806 (2023).
23. Abdelfatah, E., Ramos-Santillan, V., Cherkassky, L., Cianchetti, K. & Mann, G. High Risk, High Reward: Frailty in Colorectal Cancer Surgery is Associated with Worse Postoperative Outcomes but Equivalent Long-Term Oncologic Outcomes. *Ann. Surg. Oncol.* **30** (4), 2035–2045 (2023).
24. Normann, M., Ekerstad, N., Angenete, E. & Prytz, M. Frailty Is an Independent Marker of Post-Operative Mortality Following Colorectal Cancer Resection Surgery in Older Adults. *J. Surg. Oncol.* **132** (1), 198–204 (2025).
25. Chen, L., Zong, W., Luo, M. & Yu, H. The impact of comprehensive geriatric assessment on postoperative outcomes in elderly surgery: A systematic review and meta-analysis. *PLoS One*. **19** (8), e0306308 (2024).
26. Saur, N. M. et al. The American Society of Colon and Rectal Surgeons Clinical Practice Guidelines for the Perioperative Evaluation and Management of Frailty Among Older Adults Undergoing Colorectal Surgery. *Dis. Colon Rectum*. **65** (4), 473–488 (2022).
27. Jung, H. W. et al. Usual gait speed is associated with frailty status, institutionalization, and mortality in community-dwelling rural older adults: a longitudinal analysis of the Aging Study of Pyeongchang Rural Area. *Clin. Interv Aging*. **13**, 1079–1089 (2018).

Figures

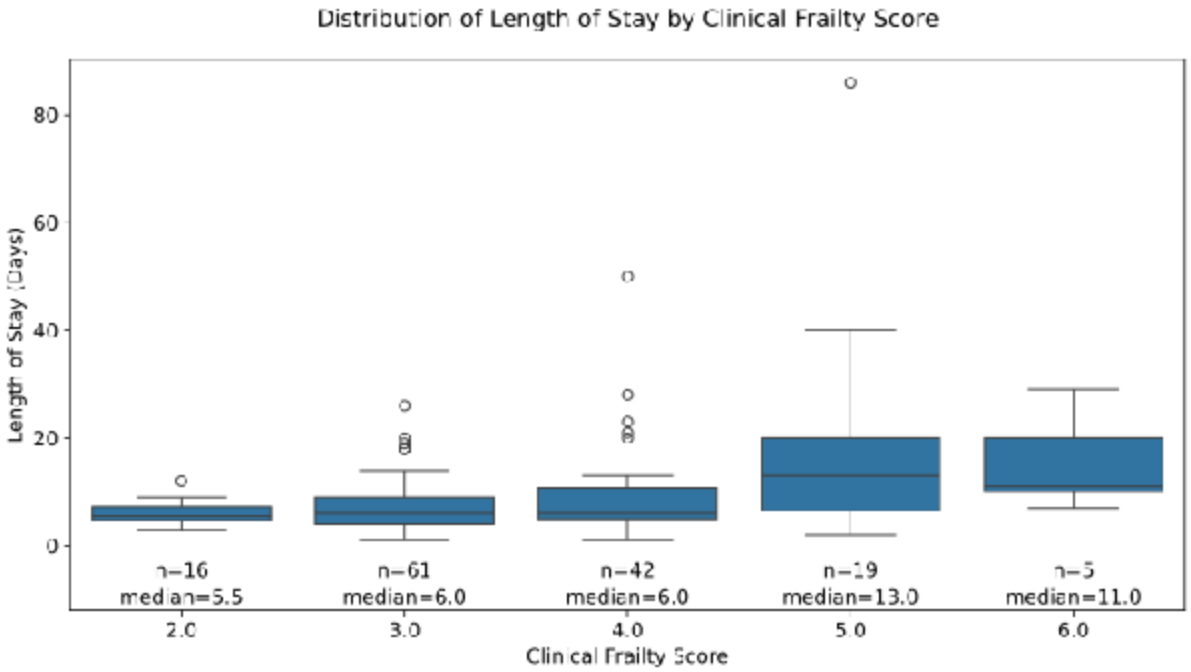


Figure 1

Distribution of hospital length of stay by Clinical Frailty Scale (CFS). Each box represents the interquartile range (IQR), the horizontal lines indicate the median, whiskers extend to 1.5×IQR, and circles denote outliers

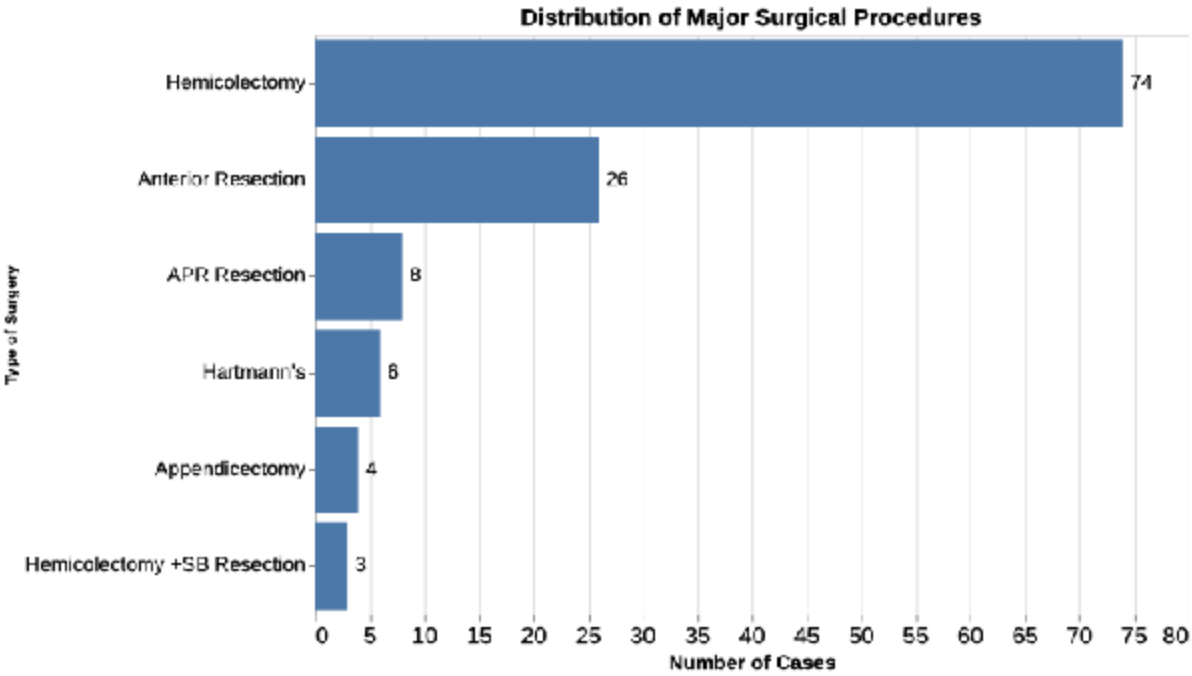


Figure 2

Frequency of major colorectal surgical procedures

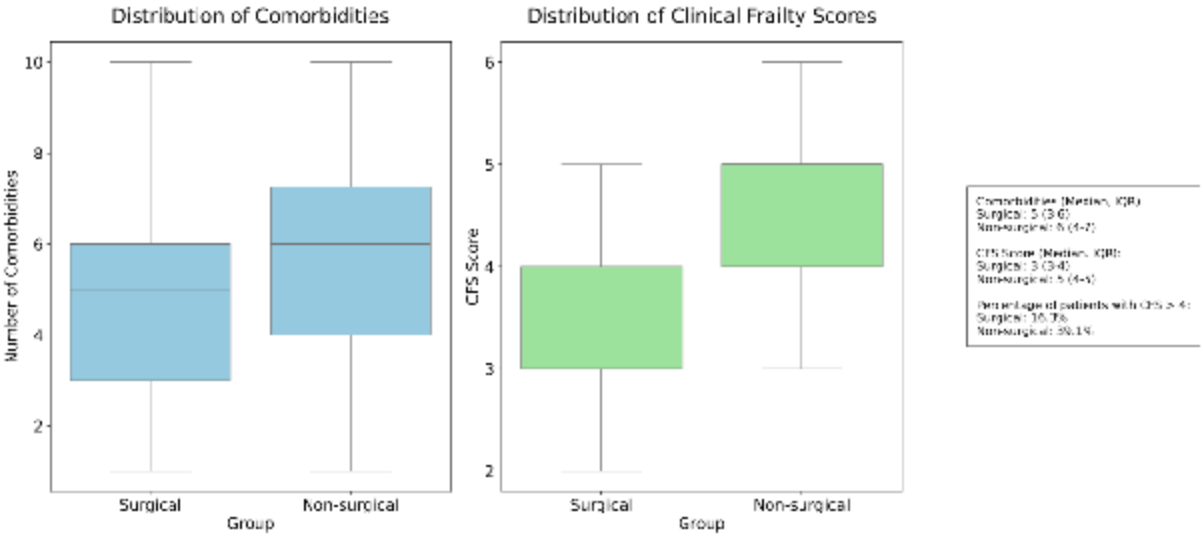


Figure 3

Clinical frailty and disease comorbidity between surgical and non-surgical patients. Whisker bars are 1.5xIQR, solid line = median

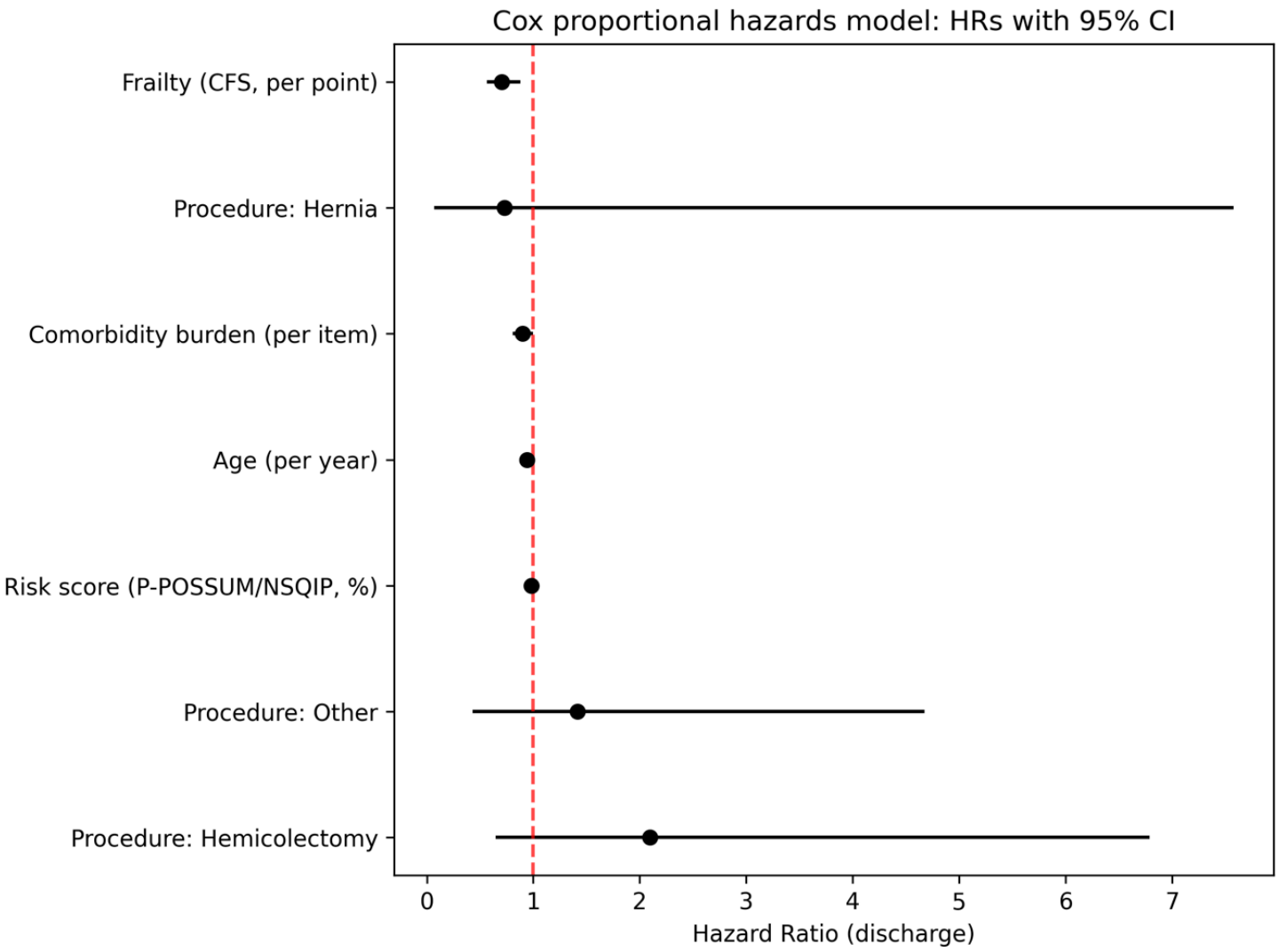


Figure 4

Adjusted Cox proportional hazards model for time to hospital discharge after colorectal resection. Forest plot showing hazard ratios (HRs) and 95% confidence intervals for age (years), Clinical Frailty Scale (CFS) score, comorbidity burden (number of recorded comorbid conditions), physiological risk (pre-operative risk estimate derived from operative risk scoring), and procedure category (categorised operative type, with comparator category defined by the model reference group). HRs below 1 indicate a lower hazard of discharge at any given time and therefore longer hospitalisation. Increasing age, higher frailty, and greater comorbidity burden were associated with reduced discharge rate.

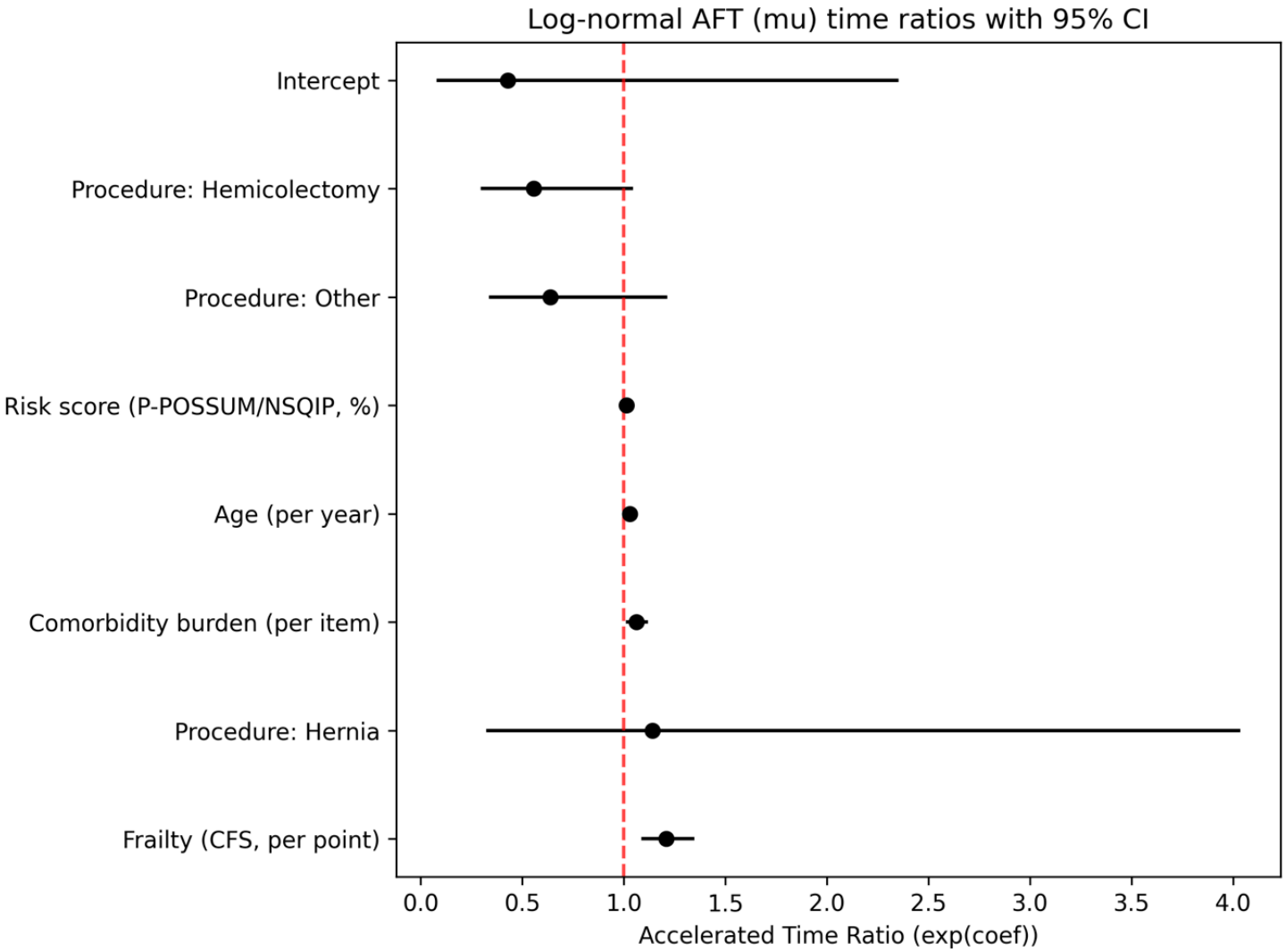


Figure 5

Adjusted lognormal accelerated failure time model for time to hospital discharge after colorectal resection. Forest plot showing acceleration time ratios (ATRs) and 95% confidence intervals for age (years), Clinical Frailty Scale (CFS) score, comorbidity burden (number of recorded comorbid conditions), and procedure category (categorised operative type, with comparator category defined by the model reference group).

ATRs above 1 indicate longer time to discharge. Increasing age, higher frailty, and greater comorbidity burden were associated with prolonged hospitalisation.

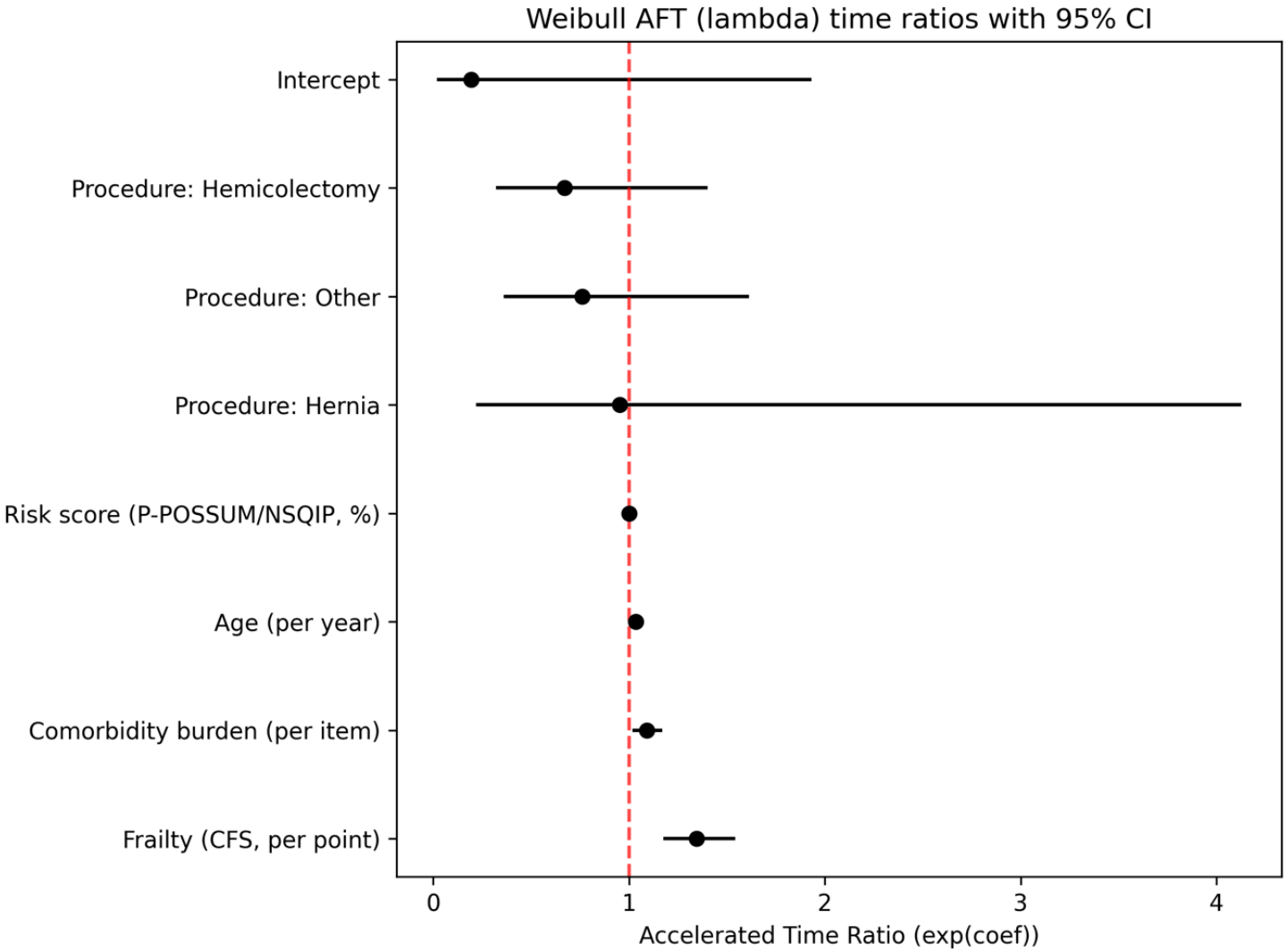


Figure 6

Adjusted Weibull accelerated failure time model for time to hospital discharge after colorectal resection. Forest plot showing acceleration time ratios (ATRs) and 95% confidence intervals for age (years), Clinical Frailty Scale (CFS) score, comorbidity burden (number of recorded comorbid conditions), and procedure category (categorised operative type, with comparator category defined by the model reference group). ATRs above 1 indicate longer time to discharge. Findings were concordant with the lognormal model, with frailty emerging as the strongest and most consistent predictor of prolonged hospitalisation.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementalAppendixLOS.docx