

Research Article

Frailty and Postoperative Outcomes in Elderly Patients Admitted to the ICU after Emergency Surgery: A Six-Month Single-Centre Cohort Analysis

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ABSTRACT

Background: Frailty may identify vulnerability that is not adequately characterized by chronological age in elderly surgical patients. This study examined associations between recorded frailty and mortality, postoperative complications, resource utilization and discharge disposition after emergency surgery requiring ICU care.

Methods: A single-centre cohort dataset comprising 100 patients aged ≥ 65 years was analyzed for a stated six-month study period. Frailty was defined as Clinical Frailty Scale (CFS) ≥ 5 . Recorded 30-day mortality was the main analytic outcome. Group comparisons, unadjusted risk ratios, exploratory Firth penalized logistic regression and score-based ROC analyses were performed.

Results: Sixty-five patients were frail and 35 were non-frail. Recorded mortality was 41.5% versus 2.9% (risk ratio 14.54, 95% CI 2.06-102.51). Frail patients had more sepsis (52.3% vs 17.1%), stage 3 acute kidney injury (36.9% vs 14.3%) and delirium (52.3% vs 20.0%). Median ventilation duration was 74 versus 29 hours, ICU stay 11 versus 5 days and hospital stay 24 versus 12 days. Age- and APACHE II-adjusted odds ratios were 27.86 (95% CI 4.42-326.38) for binary frailty and 2.59 (1.49-4.95) per CFS point. With CCI adjustment instead of APACHE II, the binary estimate attenuated to 5.64 (0.87-65.30). CFS apparent AUC was 0.769.

Conclusion: Frailty was associated with adverse recorded postoperative outcomes. Mortality estimates were imprecise and sensitive to adjustment. The findings are exploratory and should be interpreted as associations within this ICU-selected cohort.

Keywords: Frailty, Clinical Frailty Scale, Emergency Surgery, Elderly, Intensive Care, Mortality, Postoperative Complications.

INTRODUCTION

Frailty describes reduced physiological reserve and increased vulnerability to stressors arising from cumulative impairment across multiple systems. The clinical importance of this construct lies in the disproportionate deterioration that can follow an illness or intervention in a person whose compensatory capacity is limited. It is related to ageing but should not be treated as a synonym for chronological age. [1]

The phenotype described by Fried and colleagues operationalized frailty through weight loss, exhaustion, weakness, slow walking speed and low physical activity, helping distinguish it from disability and comorbidity. This distinction is relevant in perioperative assessment because patients of similar age and diagnostic burden may differ substantially in resilience and recovery potential. [2]

The Clinical Frailty Scale (CFS) offers a judgment-based summary of fitness and frailty. Its original validation demonstrated associations with subsequent mortality and institutional care, providing a practical framework for incorporating baseline functional vulnerability into clinical assessment. The original instrument and subsequent expanded versions must nevertheless be distinguished when documenting the scale used in a particular study. [3]

Emergency surgery combines acute disease with time-constrained assessment and perioperative physiological stress. Havens and colleagues showed that the excess morbidity and mortality associated with emergency general surgery were not fully explained by measured preoperative risk factors, supporting attention to additional patient-level vulnerability. [4]

The UK Emergency Laparotomy Network reported substantial mortality and marked variation in perioperative management across hospitals. Such observations show why emergency surgical outcomes need to be interpreted in relation to patient selection, procedure mix and local care processes, rather than age or operative diagnosis alone. [5]

Geriatric-specific preoperative assessment has linked frailty, disability and comorbidity markers with postoperative mortality and institutionalization. For anaesthesiologists and intensivists, this supports examining both survival and recovery-related outcomes, including duration of organ support and discharge-care needs. [6]

The present analysis examined a single-centre cohort of elderly patients receiving ICU care after emergency surgery at SSNK Memorial Medical College and Hospital, Maharashtra. The objective was to quantify associations between recorded frailty and 30-day mortality, postoperative complications, ventilation duration, ICU and hospital stay, and discharge disposition. A secondary exploratory objective was to assess the conditional association and apparent mortality discrimination of CFS after considering selected clinical covariates.

METHODS

Study design and setting

This was a single-centre observational cohort analysis of patients receiving ICU care after emergency surgery in the Department of Anaesthesia, SSNK Memorial Medical College and Hospital, Kopergaon taluka, Ahmednagar (Ahilyanagar), Maharashtra. The stated study duration was six months. Reporting was organized around the STROBE framework for observational research. [7]

Study period and participants

The cohort comprised 100 patients aged 65–88 years receiving ICU care after emergency surgery. All uploaded records were analyzed, with no analytic exclusions. The procedure mix included general abdominal operations and emergency abdominal aortic aneurysm repair; therefore, the cohort should not be described as exclusively emergency general surgery or exclusively emergency laparotomy.

Sample size

The sample size was 100. The analysis used the entire available dataset. No retrospective power calculation was used to claim adequacy for mortality or individual complications.

Data source and variables

The source dataset contained 100 records and 21 variables: patient identifier, age, sex, surgical indication/procedure, ASA physical status, presentation-to-incision interval, intraoperative blood loss and vasopressor support, CFS score and frailty classification, APACHE II score, Charlson Comorbidity Index, ventilation duration, ICU and hospital length of stay, four postoperative complication indicators, recorded 30-day mortality and discharge disposition. Coding was checked for missing cells, duplicate identifiers, agreement of CFS with frailty classification, consistency of death with disposition and obvious duration inconsistencies. Scores and outcomes were analyzed as recorded.

Frailty and other clinical scores

Frailty was defined analytically as CFS ≥ 5 ; CFS < 5 defined the non-frail group. Recorded CFS scores ranged from 2 to 8. Acute illness severity was represented by the supplied APACHE II score, a system incorporating physiological measurements, age and previous health status. [8]

Comorbidity assessment

Comorbidity burden was represented by the supplied Charlson Comorbidity Index (CCI), which summarizes prognostically relevant comorbid conditions. The individual conditions and scoring convention were not available in the dataset; the supplied total CCI was used. [9]

Outcomes

Recorded 30-day mortality was designated the main outcome for this analysis. Secondary outcomes were recorded postoperative sepsis, ARDS, stage 3 acute kidney injury, delirium, ventilation duration, ICU stay, hospital stay and discharge disposition. An analytic composite, any recorded complication, indicated at least one of the four complication fields and did not include death. Diagnoses were analyzed as recorded. The mortality field was not relabelled ICU mortality.

Descriptive and unadjusted analysis

Continuous variables are reported as median (IQR), with mean $\pm$ SD additionally given for age; categorical variables are n (%), with denominators identified. Between-group comparisons used two-sided Mann–Whitney U tests or Fisher exact tests. Global ASA and procedure comparisons used Pearson chi-

square statistics evaluated against 20,000 conditional Monte Carlo fixed-margin tables, with a plus-one correction. CFS was not tested between groups because it defined the exposure classification. Unadjusted risk ratios used log-Wald 95% confidence intervals; risk differences used Newcombe score intervals, and binomial proportions used Wilson intervals.

Exploratory adjusted analysis

Only 28 deaths occurred, including one in the non-frail group. Exploratory Firth penalized logistic regression was therefore used to reduce first-order estimation bias in the mortality models. This approach modifies maximum-likelihood estimation through a penalized likelihood rather than relying on ordinary unpenalized coefficient estimates. [10]

Model specification and sensitivity analysis

Odds ratios were accompanied by profile penalized-likelihood 95% confidence intervals and penalized likelihood-ratio tests, methods supported for sparse or separated logistic data. Four analyst-specified models were fitted: binary frailty plus age and APACHE II; continuous CFS plus age and APACHE II; continuous CFS plus age and CCI; and binary frailty plus age and CCI. Covariate sets were explored after inspecting the dataset and were not selected by automated stepwise procedures. CFS and its binary derivative were not entered together. Continuous CFS models assumed a linear association with log odds. No model was interpreted as a causal effect or complete confounder adjustment. [11]

Multiplicity and discrimination

Holm correction was applied to the five secondary complication comparisons: sepsis, ARDS, stage 3 acute kidney injury, delirium and the any-complication composite. This adjustment did not cover all analyses, and the regression and discrimination analyses remained exploratory. [12]

Prediction summaries and software

Apparent score-based AUCs were calculated for CFS, age, APACHE II and CCI, with percentile intervals from 3,000 stratified bootstrap resamples preserving 28 deaths and 72 survivors. Sensitivity, specificity and predictive values at the supplied CFS ≥ 5 threshold used Wilson intervals. No data-derived optimal

cutoff, external validation, model calibration or clinical net-benefit analysis was performed. Survivor-only duration and disposition analyses used 34 non-frail and 38 frail survivors and were treated as descriptive sensitivity analyses. No time-to-event or competing-risk analysis was performed because dates were absent. Analysis used Python with pandas, NumPy, SciPy, statsmodels and scikit-learn; simulation seed 20261017 was used. No missing-data imputation was required for the supplied cells.

Ethics and confidentiality

The study was conducted in accordance with institutional and journal requirements. Patient-level identifiers are omitted from the manuscript, tables and figures. Ethical approval, consent or waiver details, and data-sharing permissions are recorded in the Declarations section.

RESULTS

Cohort description

All 100 records were included. Mean age was 76.85 ± 6.87 years, and 57 patients were male. Sixty-five patients (65.0%) had CFS ≥ 5 and 35 (35.0%) had CFS < 5 . No missing supplied cells or duplicate patient identifiers were found. Frailty classifications agreed with the recorded scores in every case. No record had ICU stay greater than hospital stay or ventilation hours exceeding ICU days multiplied by 24. These checks establish internal consistency of selected fields, not independent clinical validity (Figure 1).

Baseline and operative characteristics

Frail patients were older and had higher APACHE II and CCI scores than non-frail patients (all $p < 0.001$). Sex distribution did not differ detectably ($p = 0.406$). Frail patients also had a longer presentation-to-incision interval, greater recorded blood loss and more frequent intraoperative vasopressor support (all $p < 0.001$; Table 1). ASA IV–V classifications occurred in 55/65 frail patients (84.6%) and 9/35 non-frail patients (25.7%). The global ASA distribution differed ($p < 0.001$), whereas the procedure distribution did not show evidence of a difference (Monte Carlo $p = 0.372$). Bowel perforation and mesenteric ischemia laparotomies were the largest procedure categories (Table 2).

Table 1. Baseline and perioperative characteristics

Characteristic	Overall (n=100)	Non-frail (n=35)	Frail (n=65)	p value
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Age, years	77.0 (71.0–83.0)	71.0 (68.0–78.0)	79.0 (74.0–85.0)	<0.001
CFS score	5.0 (4.0–6.0)	3.0 (3.0–4.0)	6.0 (5.0–6.0)	—
APACHE II score	21.0 (18.0–27.0)	17.0 (14.0–19.0)	25.0 (21.0–29.0)	<0.001
Charlson Comorbidity Index	3.0 (3.0–5.0)	2.0 (1.0–3.0)	4.0 (3.0–5.0)	<0.001
Presentation-to-incision interval, hours	3.2 (2.4–4.5)	2.5 (1.8–3.1)	3.7 (2.9–5.2)	<0.001
Intraoperative blood loss, mL	764.5 (487.8–1158.8)	472.0 (247.5–617.5)	1054.0 (744.0–1251.0)	<0.001
Male sex	57 (57.0)	22 (62.9)	35 (53.8)	0.406
Intraoperative vasopressor support	64 (64.0)	12 (34.3)	52 (80.0)	<0.001

Values are median (IQR) or n (%). Mann–Whitney U tests for continuous measures and Fisher exact tests for binary measures. CFS is

descriptive because it defines the groups. Baseline p values do not identify or exclude confounding.

Table 2. ASA physical status and recorded procedure categories

Characteristic	Overall (n=100)	Non-frail (n=35)	Frail (n=65)	p value
ASA III	36 (36.0)	26 (74.3)	10 (15.4)	<0.001
ASA IV	53 (53.0)	7 (20.0)	46 (70.8)	—
ASA V	11 (11.0)	2 (5.7)	9 (13.8)	—
Emergency Abdominal Aortic Aneurysm Repair	9 (9.0)	5 (14.3)	4 (6.2)	0.372
Emergency Laparotomy for Bowel Perforation	24 (24.0)	9 (25.7)	15 (23.1)	—
Emergency Laparotomy for Mesenteric Ischemia	23 (23.0)	9 (25.7)	14 (21.5)	—
Gangrenous Cholecystectomy	14 (14.0)	4 (11.4)	10 (15.4)	—
Obstructed Inguinal Hernia Repair	19 (19.0)	7 (20.0)	12 (18.5)	—
Peritonitis secondary to Appendiceal Perforation	11 (11.0)	1 (2.9)	10 (15.4)	—

Values are n (%). Global ASA and procedure p values use 20,000 conditional fixed-margin Monte Carlo Pearson chi-square simulations with a plus-one correction. Procedure labels are retained from the dataset. Procedure comparisons include vascular surgery.

Recorded mortality

Twenty-eight patients (28.0%) were recorded as dead at 30 days. Mortality was 27/65 (41.5%) in the frail group and 1/35 (2.9%) in the non-frail group (Fisher $p<0.001$). The unadjusted risk ratio was 14.54 (95% CI 2.06–102.51), and the absolute risk difference was 38.7 percentage points (95% CI 22.5–51.0; Table 3). Mortality was higher at the upper

observed CFS levels, but individual scores did not show a strictly monotonic pattern. For example, mortality was 25.0% at CFS 2, based on one death among four patients, and 66.7%

at CFS 8, based on two deaths among three patients. These small strata had wide confidence intervals (Figure 2; Supplementary Table S1).

Table 3. Recorded mortality and postoperative complications

Outcome	Overall	Non-frail	Frail	Risk ratio (95% CI)	Risk difference, pp (95% CI)	Fisher p value	Holm-adjusted p value
Recorded 30-day mortality	28 (28.0)	1 (2.9)	27 (41.5)	14.54 (2.06–102.51)	38.7 (22.5–51.0)	<0.001	—
Postoperative sepsis	40 (40.0)	6 (17.1)	34 (52.3)	3.05 (1.42–6.55)	35.2 (15.6–49.9)	<0.001	0.002
Postoperative ARDS	16 (16.0)	2 (5.7)	14 (21.5)	3.77 (0.91–15.65)	15.8 (0.5–28.0)	0.047	0.047
Stage 3 acute kidney injury	29 (29.0)	5 (14.3)	24 (36.9)	2.58 (1.08–6.18)	22.6 (4.1–37.2)	0.021	0.042
Postoperative delirium	41 (41.0)	7 (20.0)	34 (52.3)	2.62 (1.30–5.28)	32.3 (12.4–47.6)	0.003	0.008
Any recorded complication	75 (75.0)	17 (48.6)	58 (89.2)	1.84 (1.29–2.61)	40.7 (22.0–57.2)	<0.001	<0.001

Values are n (%). Risk ratio: frail/non-frail; log-Wald 95% CI. Risk differences are frail minus non-frail in percentage points (pp), with Newcombe intervals. Two-sided Fisher p values. Holm adjustment covers only five complication comparisons. Any recorded

complication is at least one of sepsis, ARDS, stage 3 acute kidney injury or delirium; death is excluded. ARDS has method-sensitive evidence: risk-ratio CI includes 1 despite Fisher p=0.047.

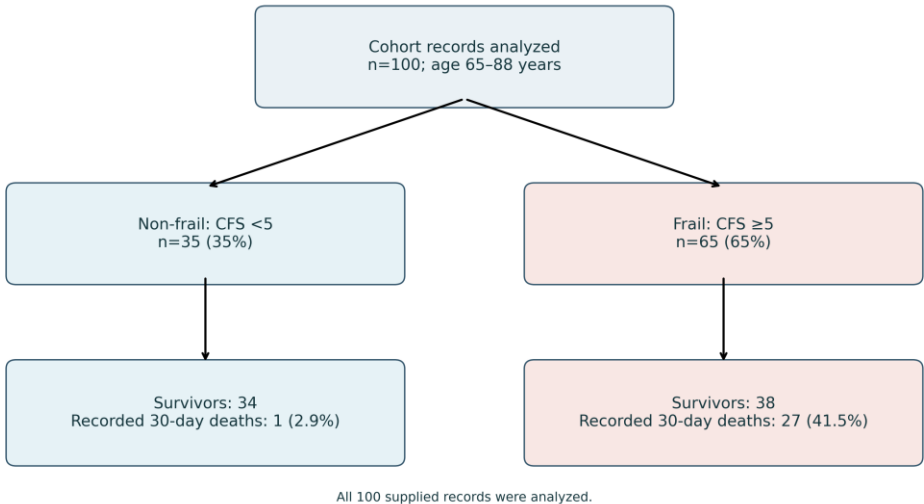


Figure 1. Cohort records and recorded 30-day mortality

All 100 uploaded records were included in the analysis. The diagram describes the analyzed

dataset and does not imply a verified recruitment or screening process.

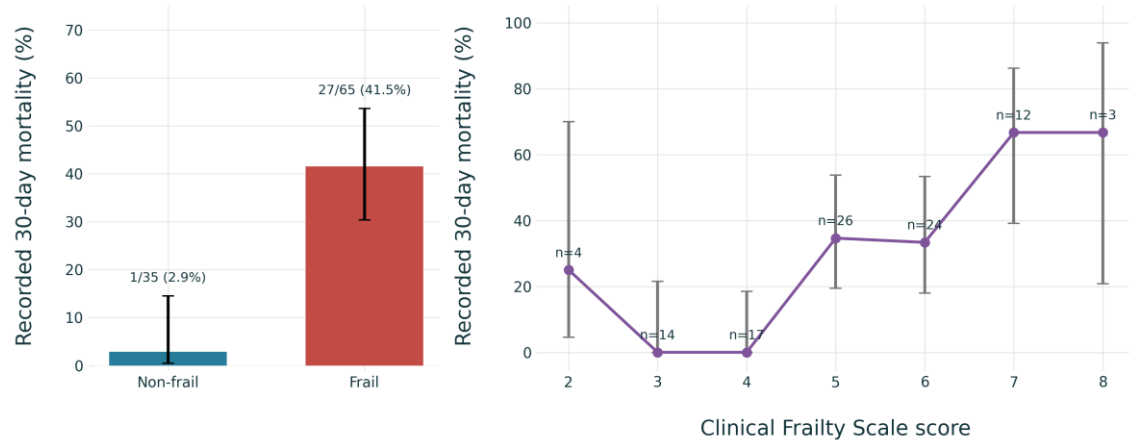


Figure 2. Recorded 30-day mortality by frailty category and individual CFS score

Error bars indicate Wilson 95% confidence intervals. Individual CFS strata are small and

the observed relationship is not strictly monotonic.

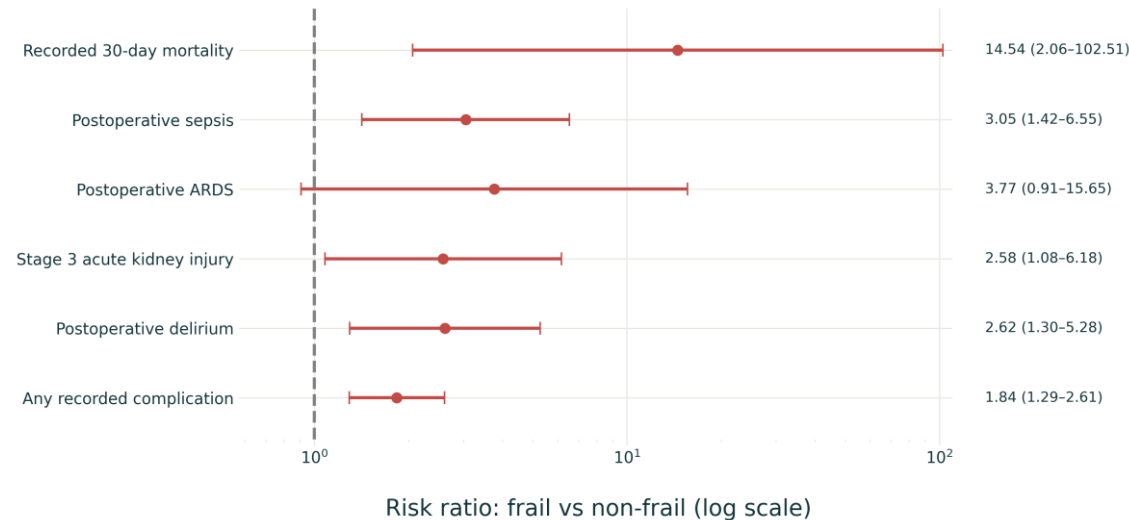


Figure 3. Unadjusted outcome risk ratios

Intervals use the log-Wald method. The ARDS interval spans 1 despite a Fisher p value of 0.047 because the interval and hypothesis test use different inferential methods.

Postoperative complications

Sepsis, stage 3 acute kidney injury and delirium were more frequent in frail patients. Risk ratios were 3.05 (95% CI 1.42–6.55), 2.58 (1.08–6.18) and 2.62 (1.30–5.28), respectively. Any recorded complication occurred in 89.2% of frail patients compared with 48.6% of non-frail patients (risk ratio 1.84, 95% CI 1.29–2.61). Holm-adjusted p values were 0.002 for sepsis, 0.042 for stage 3 acute kidney injury, 0.008 for delirium and <0.001 for the composite. ARDS

occurred in 21.5% versus 5.7% (risk ratio 3.77, 95% CI 0.91–15.65). Although its Fisher and Holm-adjusted p values were 0.047, the log-Wald risk-ratio interval crossed 1; this was a borderline, method-sensitive finding (Table 3; Figure 3).

Ventilation and length of stay

Median ventilation duration was 74.0 (IQR 57.0–98.0) hours in frail patients versus 29.0 (21.5–36.5) hours in non-frail patients. Median ICU stay was 11.0 (9.0–15.0) versus 5.0 (3.0–6.0) days, and hospital stay 24.0 (21.0–30.0) versus 12.0 (10.0–13.5) days. All distributional comparisons had $p < 0.001$ (Table 4; Figure 4). Among survivors, the corresponding frail versus

non-frail medians were 73.5 versus 29.0 ventilation hours, 12.0 versus 5.0 ICU days and 24.0 versus 12.0 hospital days. Every supplied

record contained positive ventilation duration, so the analysis did not evaluate the probability of requiring ventilation.

Table 4. Mechanical ventilation and length of stay

Outcome	Population	Overall	Non-frail	Frail	p value
Mechanical ventilation duration, hours	All patients	56.0 (30.8–82.2)	29.0 (21.5–36.5)	74.0 (57.0–98.0)	<0.001
Mechanical ventilation duration, hours	Survivors only	44.0 (27.8–74.0)	29.0 (20.8–36.8)	73.5 (56.0–88.2)	<0.001
ICU length of stay, days	All patients	9.0 (5.0–12.0)	5.0 (3.0–6.0)	11.0 (9.0–15.0)	<0.001
ICU length of stay, days	Survivors only	7.0 (5.0–12.2)	5.0 (3.0–6.0)	12.0 (10.0–15.0)	<0.001
Hospital length of stay, days	All patients	21.0 (13.0–26.2)	12.0 (10.0–13.5)	24.0 (21.0–30.0)	<0.001
Hospital length of stay, days	Survivors only	16.0 (12.0–24.0)	12.0 (10.0–13.8)	24.0 (21.2–31.8)	<0.001

Values are median (IQR). All-patient denominators: 100 overall, 35 non-frail, 65 frail. Survivor denominators: 72 overall, 34 non-frail, 38 frail. Two-sided Mann–Whitney U tests

evaluate distributions, not specifically medians. Death can truncate durations; survivor analyses condition on survival.

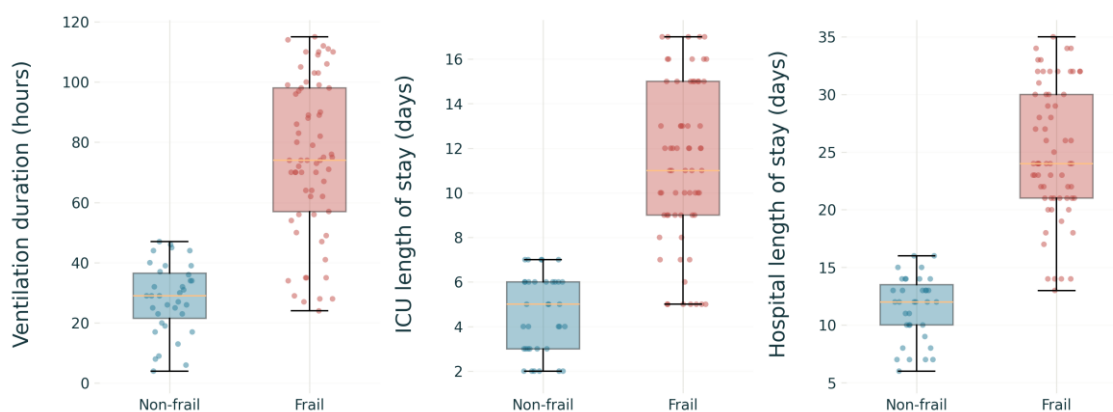


Figure 4. Postoperative resource utilization

Boxes show medians and interquartile ranges; whiskers extend to 1.5 IQR, and dots show individual observations. All-patient comparisons use two-sided Mann–Whitney U tests. Duration outcomes may be truncated by death.

Discharge disposition

The overall recorded destinations were home unassisted in 30 patients, home with assistive care in 16, rehabilitation in 26 and death in 28.

Among survivors, 30/34 non-frail patients (88.2%) were discharged home unassisted and 4/34 (11.8%) required home assistance. No frail survivor was recorded as discharged home unassisted: 12/38 (31.6%) required home assistance and 26/38 (68.4%) entered rehabilitation (Table 5; Figure 6). Baseline residence and support needs were not available to determine whether dependence was new.

Table 5. Recorded discharge disposition

Population	Recorded discharge disposition	Overall	Non-frail	Frail
All patients	Discharged Home Unassisted	30 (30.0)	30 (85.7)	0 (0.0)
All patients	Discharged Home with Assistive Care	16 (16.0)	4 (11.4)	12 (18.5)
All patients	Expired in ICU/Hospital	28 (28.0)	1 (2.9)	27 (41.5)
All patients	Sub-acute Rehab Facility	26 (26.0)	0 (0.0)	26 (40.0)

Survivors only	Discharged Home Unassisted	30 (41.7)	30 (88.2)	0 (0.0)
Survivors only	Discharged Home with Assistive Care	16 (22.2)	4 (11.8)	12 (31.6)
Survivors only	Sub-acute Rehab Facility	26 (36.1)	0 (0.0)	26 (68.4)

Values are n (%). All-patient denominators: 100/35/65 (overall/non-frail/frail). Survivor denominators: 72/34/38. Categories describe

recorded destination, not confirmed new disability or change from baseline support.

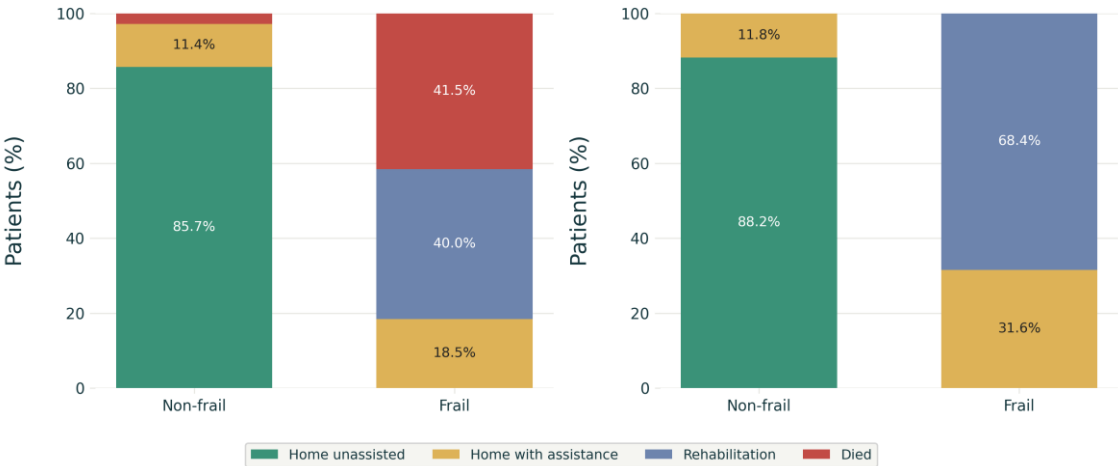


Figure 6. Recorded discharge disposition.

All-patient denominators are 35 non-frail and 65 frail; survivor denominators are 34 and 38. No frail survivor was recorded as discharged home unassisted. The categories describe recorded destination and do not establish new disability without baseline function.

Exploratory adjusted mortality models

After adjustment for age and APACHE II, binary frailty had odds ratio 27.86 (95% profile-likelihood CI 4.42–326.38; $p<0.001$). Continuous CFS had odds ratio 2.59 per point

(1.49–4.95; $p<0.001$) with the same adjustment. Substituting CCI for APACHE II attenuated the continuous-CFS estimate to odds ratio 1.63 (1.002–2.74; $p=0.049$), and the binary-frailty estimate to odds ratio 5.64 (0.87–65.30; $p=0.071$). Thus, the binary association did not remain below the 0.05 p -value threshold across adjustment sets (Table 6). CFS correlated with APACHE II (Pearson $r=0.711$) and CCI ($r=0.640$), indicating substantial shared information among these recorded measures.

Table 6. Exploratory Firth penalized mortality models

Model	Predictor	Odds ratio	95% profile-likelihood CI	p value
M1: Binary frailty + age + APACHE II	Frail vs non-frail	27.86	4.42–326.38	<0.001
M1: Binary frailty + age + APACHE II	Age, per year	1.02	0.95–1.11	0.537
M1: Binary frailty + age + APACHE II	APACHE II, per point	0.93	0.82–1.05	0.217
M2: CFS + age + APACHE II	CFS, per point	2.59	1.49–4.95	<0.001
M2: CFS + age + APACHE II	Age, per year	1.00	0.92–1.08	0.990
M2: CFS + age + APACHE II	APACHE II, per point	0.94	0.82–1.06	0.289
M3: CFS + age + CCI	CFS, per point	1.63	1.002–2.74	0.049
M3: CFS + age + CCI	Age, per year	1.02	0.94–1.10	0.717
M3: CFS + age + CCI	CCI, per point	1.57	1.05–2.40	0.026

M4: Binary frailty + age + CCI	Frail vs non-frail	5.64	0.87–65.30	0.071
M4: Binary frailty + age + CCI	Age, per year	1.03	0.95–1.11	0.472
M4: Binary frailty + age + CCI	CCI, per point	1.46	0.94–2.32	0.093

Firth bias-reduced logistic regression; odds ratio. Intervals are profile penalized-likelihood 95% CIs; p values use penalized likelihood-ratio tests. All models were analyst-specified after dataset inspection and are exploratory. Odds ratios are not risk ratios. The CFS/CCI lower bound is shown to three decimals to avoid obscuring its proximity to 1.

Apparent discrimination and threshold performance

CFS had an apparent AUC of 0.769 (95% bootstrap CI 0.663–0.860), compared with

0.628 (0.506–0.738) for age, 0.653 (0.545–0.760) for APACHE II and 0.761 (0.665–0.847) for CCI (Table 7; Figure 5). At CFS ≥ 5 , sensitivity was 96.4% (27/28) and specificity 47.2% (34/72). Positive and negative predictive values were 41.5% (27/65) and 97.1% (34/35), respectively (Table 8). These results describe classification within this cohort rather than a validated individual prediction tool.

Table 7. Apparent score-based mortality discrimination

Score	Apparent AUC	95% stratified-bootstrap CI
CFS	0.769	0.663–0.860
AGE	0.628	0.506–0.738
APACHE	0.653	0.545–0.760
CCI	0.761	0.665–0.847

Apparent univariable score-based AUCs. Percentile 95% CIs use 3,000 stratified bootstrap resamples. These are not optimism-corrected or externally validated estimates and

do not establish incremental prediction beyond another model. Labels AGE and APACHE refer to age and APACHE II.

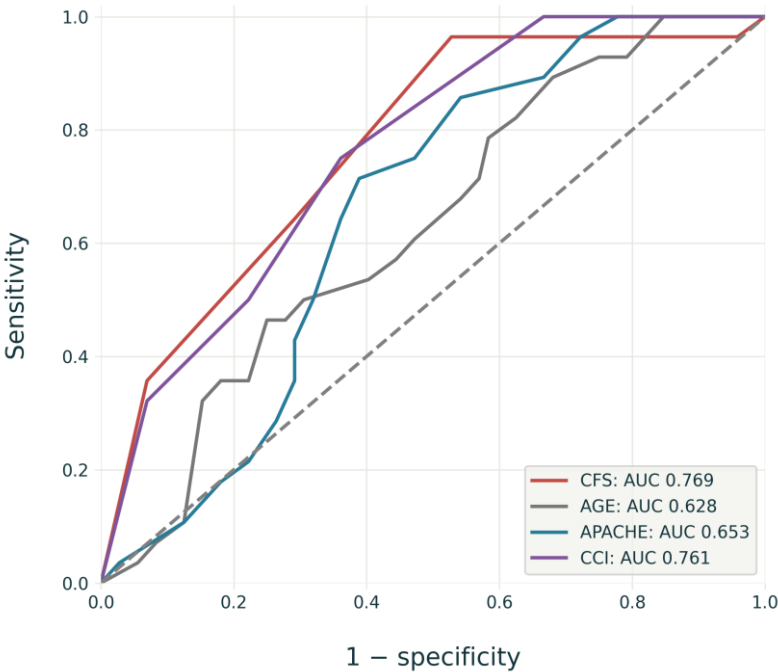


Figure 5. ROC curves for recorded 30-day mortality.

AUCs are apparent within-sample score-based estimates, not externally validated prediction

performance. Bootstrap confidence intervals are shown in Table 7.

Table 8. CFS ≥ 5 classification performance

CFS ≥ 5 metric	n/N	Estimate (%)	95% Wilson CI (%)
Sensitivity	27/28	96.4	82.3–99.4
Specificity	34/72	47.2	36.1–58.6
Positive predictive value	27/65	41.5	30.4–53.7
Negative predictive value	34/35	97.1	85.5–99.5
Accuracy	61/100	61.0	51.2–70.0

CFS ≥ 5 defines a positive high-risk classification. Wilson 95% CIs. Predictive values depend on this cohort's 28% mortality prevalence. Accuracy should not be used as the sole performance measure.

DISCUSSION

Principal findings

In this 100-record cohort, frailty was associated with higher recorded mortality, a greater burden of several postoperative complications, longer organ support and hospital stays, and more assistance at discharge. The main qualification is the instability of adjusted mortality estimates: the association was stronger with age and APACHE II adjustment than with age and CCI adjustment. The findings therefore support a prognostic association within the supplied data, not a definitive independent or causal effect.

Comparison with emergency surgical cohorts

The multicentre ELF study included 937 older patients undergoing emergency laparotomy and reported frailty in approximately one-fifth, with progressively greater adjusted mortality at higher CFS categories. Its findings support the direction of the present association. However, the much higher frailty prevalence in this ICU-selected cohort may reflect selection, operative case mix or assessment differences; it cannot be interpreted as an institutional or national prevalence comparison. ELF also emphasized 90-day outcomes, whereas the present mortality field was labelled 30-day. [13]

Consistency and magnitude of the mortality association

Fehlmann and colleagues pooled evidence in adults aged ≥ 65 years undergoing emergency general surgery and reported an unadjusted 30-day mortality odds ratio of 2.91 (95% CI 2.00–4.23) for frail versus non-frail patients.

The current results are directionally consistent, but the pooled odds ratio should not be directly compared with the present risk ratio. The present binary logistic estimate is especially unstable because only one non-frail patient died. Differences in ICU selection, vascular surgery inclusion, assessment timing and residual confounding further limit numerical comparisons. [14]

Complications and hospital resource use

Leiner and colleagues synthesized a broader emergency surgical literature and found associations between frailty and adverse survival and hospital-use outcomes. Their review included diverse tools and patient pathways, illustrating why agreement in direction need not imply a common effect size. Here, sepsis, delirium and stage 3 acute kidney injury remained different after the limited Holm adjustment, whereas the ARDS result was method-sensitive. These findings do not demonstrate that frailty itself caused infection, organ injury or delayed recovery; acute severity, procedure-related factors and treatment processes may contribute to the observed differences. [15]

Relationship to general ICU evidence

In a systematic review of 10 observational studies involving 3,030 ICU patients, Muscedere and colleagues found higher hospital mortality in frail patients (risk ratio 1.71, 95% CI 1.43–2.05) and a lower likelihood of discharge home. In contrast to the strong duration differences in the present dataset, pooled ICU length of stay was not significantly different in that review. This contrast argues against assuming that frailty invariably prolongs ICU care. Death, treatment limitations and discharge practice may alter observed durations, and survivor-only analyses do not remove these competing influences. [16]

Recovery rather than survival alone

Bagshaw and colleagues demonstrated associations between frailty and adverse short- and long-term critical-care outcomes, including subsequent dependence among survivors. This supports measuring recovery as a distinct domain rather than restricting assessment to mortality. Nevertheless, the present discharge categories cannot be equated with newly acquired dependence: no baseline activities of daily living, prior residence or pre-existing assistance data were supplied. The absence of any unassisted discharge among frail survivors is unusually complete and should be interpreted cautiously. [17]

Age, selection and generalizability

The VIP1 study enrolled 5,021 ICU patients aged ≥ 80 years, reported frailty in 43.1%, and found an association with 30-day mortality. That population differs materially from the current patients aged 65–88 years and included a broader critical-care case mix. The comparison supports attention to frailty across older ICU populations but does not justify applying either study's absolute risks to a different age group, operative population or admission policy. The present analysis also lacks information about patients who were not offered surgery or ICU admission. [18]

Frailty, comorbidity and model dependence

VIP2 evaluated 3,920 acutely admitted ICU patients aged ≥ 80 years and showed that frailty retained prognostic information in a multivariable framework, while several geriatric measures were closely related. The attenuation seen here after CCI adjustment is compatible with overlapping information, although this small dataset cannot determine the mechanism. The nonsignificant inverse APACHE II coefficients in the adjusted models should not be interpreted as protective. APACHE II already incorporates age-related information, and an age-adjusted CCI would create additional overlap; the source scoring conventions therefore require caution. [19]

Interpreting apparent prediction performance

Brummel and colleagues linked greater baseline frailty with subsequent mortality and instrumental-activity disability in a large critical-illness cohort, emphasizing outcomes beyond the index admission. The present study assessed neither longitudinal disability nor cognitive recovery. Its CFS AUC of 0.769

represents apparent discrimination only. CFS and CCI had similar AUC point estimates, and the CFS ≥ 5 threshold combined high sensitivity with limited specificity. Without external validation, calibration and an evaluation of added value, these findings do not establish a clinical decision rule or justify using a frailty cutoff alone to determine treatment eligibility. [20]

Clinical and research implications

The data support further evaluation of structured baseline frailty assessment alongside acute severity, comorbidity and patient priorities in emergency perioperative care. A reasonable research direction is to test whether such assessment improves communication, recovery planning and allocation of supportive services; this analysis does not show that screening or a frailty-directed intervention improves outcomes. Any local pathway should avoid treating a group-level association as an individual prognosis or using the observed threshold as a standalone rule to withhold treatment. Future cohorts should capture baseline function, procedure severity, treatment limitations, exact event dates, complete post-discharge follow-up and patient-centred recovery measures.

Strengths

The analysis used all supplied records, retained the supplied CFS threshold, reported absolute and relative effects with uncertainty, and addressed sparse mortality data using penalized estimation. Explicit denominators distinguish all-patient and survivor outcomes. Sensitivity models, multiplicity adjustment for a defined complication family and transparent reporting of borderline findings reduce the risk of presenting a single favourable analysis as definitive.

Limitations

First, the dataset cannot establish original-record provenance, prospective design, consecutive recruitment, eligibility screening or follow-up completeness. Second, the six-month recruitment dates and timing of CFS and severity measurements are absent. Third, diagnoses were analyzed as recorded without clinical adjudication or confirmed consensus definitions. Fourth, the 28 deaths, including only one non-frail death, limit precision despite penalization. Fifth, adjustment was restricted to selected covariates, and important factors such as baseline function, nutrition, procedure

complexity, treatment limitations and care pathways were unavailable. Sixth, continuous CFS models imposed linear log odds despite small, non-monotonic score strata. Seventh, complete-case spreadsheet fields do not imply complete clinical information. Eighth, duration outcomes are affected by death, and survivor-only analyses introduce selection. Ninth, ROC performance was estimated in the same cohort without external validation or optimism correction. Finally, the selected single-centre ICU cohort, including vascular procedures, limits transportability. These limitations prevent a definitive claim that frailty independently predicts outcomes across elderly emergency surgical populations.

CONCLUSION

Among 100 elderly emergency surgical patients with postoperative ICU care in the supplied cohort, frailty was associated with higher recorded 30-day mortality, more postoperative complications, longer ventilation and ICU/hospital stays, and greater recorded discharge-care needs. CFS showed apparent mortality discrimination, but effect estimates were imprecise and the binary mortality association was sensitive to comorbidity adjustment. The findings should be interpreted as exploratory associations within this ICU-selected cohort.

Declarations

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Conflicts of interest

The authors declare that they have no conflicts of interest.

Author contributions

All authors contributed to study design, data interpretation, manuscript preparation and final approval. The corresponding author is responsible for the accuracy and integrity of the work.

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Study duration:

Six months | Sample analyzed: 100

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Supplementary Table S1. Recorded mortality by individual CFS score

CFS score	Patients	Deaths	Mortality (%)	95% Wilson CI (%)
2	4	1	25.0	4.6–69.9
3	14	0	0.0	0.0–21.5
4	17	0	0.0	0.0–18.4
5	26	9	34.6	19.4–53.8
6	24	8	33.3	18.0–53.3
7	12	8	66.7	39.1–86.2
8	3	2	66.7	20.8–93.9

Wilson 95% confidence intervals. Small strata preclude a firm monotonic dose–response conclusion.