The impact of frailty and geriatric syndromes on metrics of acute care performance: results of a national day of care survey

Thomas Knight,[a,*] Catherine Atkin,[a] Vicky Kamwa,[a] Tim Cooksley,[b] Chris Subbe,[c] Mark Holland,[d] Elizabeth Sapey,[a] and Daniel Lasserson[e]

[a]Birmingham Acute Care Research Group, Institute of Inflammation and Ageing, University of Birmingham, UK
[b]The Christie NHS Foundation Trust, Manchester, UK
[c]School of Medical and Health Sciences, Bangor University, UK
[d]School of Clinical and Biomedical Sciences, University of Bolton, UK
[e]Warwick Medical School, University of Warwick, UK

eClinicalMedicine 2023;■: 102278

Published Online XXX https://doi.org/10.1016/j.eclinm.2023.102278

Summary

Background Frailty is associated with a range of adverse clinical outcomes in the acute hospital setting. We sought to determine whether frailty and related factors affected clinical processes such as time to assessment during emergency hospital admission within the National Health Service (NHS) in the UK.

Methods The Society for Acute Medicine Benchmarking Audit (SAMBA) is an annual cross-sectional day of care survey. SAMBA 2022 was conducted on Thursday 23rd June 2022. We assessed whether the Clinical Frailty Scale (CFS) and presence of a geriatric syndrome affected performance against nationally recognised clinical quality indicators based on time to initial assessment and time to consultant review. CFS was graded into robust (CFS1-3), mild (CFS 4-5), moderate (CFS 6), severe (CFS7-8) and terminal illness (CFS 9). Plausible values were created for missing variables using multi-level multiple imputation. The association was described using mixed effect generalised linear models adjusting for initial National Early Warning Score 2 (NEWS2) and time of arrival.

Findings A total of 152 hospitals provided patient level data relating to 7248 emergency medical admissions. Patients with mild, moderate and severe frailty were less likely to be assessed within 4 h of arrival (adjusted OR, mild 0.79, 95% CI 0.68–0.96, moderate 0.67 95% CI 0.53–0.84, severe, 0.75 95% CI 0.58–0.96, terminally ill 0.59 95% CI 0.23–1.43) and less likely to be achieve the clinical quality indicator for consultant review (adjusted OR, mild 0.69 95% CI 0.58–0.83, moderate 0.55 95% CI 0.44–0.70, severe 0.54 95% CI 0.41–0.69, terminally ill 0.76 95% CI 0.42–1.5). Patients with geriatric syndromes were also less likely to be assessed within 4 h of arrival (adjusted OR 0.66 95% CI 0.56–0.76) or by a consultant within the recommended time frame (adjusted OR 0.45 95% CI 0.39–0.51). The difference was partially explained by differential use of SDEC pathways. Sub-group analysis of 5148 patients assessed outside of SDEC areas demonstrated patients with geriatric syndromes (adjusted OR 0.71, 95% CI 0.60–0.83), but not frailty defined by CFS were less likely to be assessed within 4 h of arrival. Moderate and severe frailty and the presence of a geriatric syndrome were associated with a decreased likelihood of achieving the consultant review standard (moderate, adjusted OR 0.75, 95% CI 0.59–0.94, severe adjusted OR 0.75 95% CI 0.58–0.96, geriatric syndrome adjusted OR 0.59, 95% CI 0.50–0.69).

Interpretation Frailty is associated with delayed clinical assessment. This association may suggest a systemic issue with clinical prioritisation, with important implications for acute care policy.

Funding The database for SAMBA is funded by the Society for Acute Medicine.

Keywords: Acute care; Older people; Geriatric syndromes; Frailty; SAMBA

Introduction

Older people are frequent users of emergency and urgent care services.[1] In England, patients aged over 65 represent around 1 in 5 Emergency Department (ED) attendances but are disproportionally more likely to require emergency medical admission.[2,3] Frailty is a multi-system clinical syndrome related to but not synonymous with ageing, which describes a reduced

*Corresponding author.
E-mail address: thomasknight@nhs.net (T. Knight).

Research in context

Evidence before this study

Older patients living with frailty are at high risk of acute deterioration in health necessitating hospital assessment to diagnose and treat underlying causes. The association between frailty and adverse clinical outcomes is well recognised. The impact of frailty on process outcomes, such as the timing of clinical assessment is less well defined.

Added value of this study

This multi-centre single day of care survey conducted within the United Kingdom demonstrates people with frailty defined using the Clinical Frailty Scale or the presence of a geriatric syndrome are less likely to have an initial assessment within 4 h or consultant assessment within time thresholds defined by national clinical quality standards (6 h in those arriving in core hours and 14 h in those arriving out of hours).

Implications of all the available evidence

Our study demonstrates older people living with frailty may not be appropriately prioritised within the acute care pathway. This is in contrast with existing evidence demonstrating a clear relationship between frailty and adverse outcomes during emergency medical admission.

capacity to withstand or recover quickly from relatively minor stressors.[4] Frailty is distinct from the concepts of multi-morbidity and disability although there is considerable overlap.[5] Frailty is associated with a diverse range of adverse outcomes during emergency admission including mortality, increased length of stay, readmission and discharge to institutional care.[6–8]

In the UK, the dominant model of acute care delivery for patients with medical illness is centred around Acute Medical Units (AMUs). AMUs are a "dedicated facility within the hospital that act as the focus for acute medical care for patients who have presented as a medical emergency to hospital".[9] The standard acute care pathway involves assessment in the ED followed by referral to the acute medical team, led by internal medicine physicians, and admission to the AMU when inpatient care is necessary. The ED and acute medical team are distinct entities, and the process of admission typically involves sequential assessment by both teams.[10]

Acute care performance is deteriorating, as evidenced by increasing waiting times in the ED, high bed-occupancy and delayed transfers of care across care interfaces.[2] These trends were evident prior to the coronavirus-19 pandemic but have accelerated in the recovery period. Acute care service redesign to enhance the provision of Same day emergency care (SDEC) is a key tenet of national policy intended to reduce bed-occupancy and maintain patient flow through the acute care pathway.[11] SDEC is delivered by acute medical services and provides an alternative to hospital admission by allowing early access to senior clinical decision makers and diagnostics.[12]

Approaches to SDEC vary between organisations and typically involve processes to identify patients based on expectation of discharge and assessment and treatment pathways that avoid the need for overnight bed-based admission.[13] SDEC is typically provided within distinct clinical areas of hospitals geographically separated from the ED and AMU. The SDEC approach is increasingly applied to the assessment and management of older people with frailty through the provision of acute frailty services.[14] A potential risk of this approach is that the reallocation of resources to prioritise lower acuity patients may have unintended consequences on the provision of care for those requiring emergency admission to an inpatient bed.

The Society for Acute Medicine (SAM) undertake an annual day-of-care service evaluation, the Society for Acute Medicine Benchmarking Audit (SAMBA). SAMBA uses clinical quality indicators based on process outcomes to measure acute care performance at the national level.[15] We aimed to establish whether frailty was associated with differences in clinical quality indicators measured during the first 24-h of emergency medical admission.

Methods

Study design

SAMBA is a cross-sectional service evaluation conducted annually on the penultimate Thursday in June. All hospitals in the UK receiving acutely unwell (non-elective, adult) medical patients are eligible to participate. Non-acute and community hospitals are excluded. Patient level data were collected on Thursday 23rd June 2022 between 00:00 and 23:59. All patients referred to acute medical during the study period were eligible for inclusion. Patients presenting for planned follow up by acute medical services were excluded from analysis. Data were collected electronically using a web-based data collection interface.[16] Data collection is undertaken by named members of the acute medicine team at each site. All variables were collected during the delivery of routine care and ascertained by retrospective review of the clinical care record. The SAMBA22 protocol and data collection forms were published in advance.[17]

Predictor variables

Frailty was recorded at the patient level using two variables. These included the Clinical Frailty Scale (CFS)[18] and the presence of a geriatric syndrome on admission. The rationale for inclusion of geriatric syndromes

in addition to CFS was to differentiate people with pre-existing frailty presenting with a discrete medical complaint (e.g., myocardial infarction) from those presenting with multi-system syndromic conditions related to frailty (e.g., delirium).

Documentation of the CFS during the admission process is recommended within multiple national guidelines and its use is prevalent amongst hospitals participating in SAMBA.[19] A guide to calculating the CFS was provided within the data collection tool. This included a statement that the CFS is based on a functional assessment two weeks prior to admission. CFS was analysed in five risk categories, robust with no evidence of frailty (CFS 1-3), mild frailty (CFS 4-5), moderate frailty (CFS 6), severe frailty (CFS 7-8) and terminal illness (CFS 9).[14,20] If the CFS was not recorded within the clinical record it was estimated using available information. The process of retrospective ascertainment of CFS has been shown to have acceptable levels of agreement with prospectively determined scores in the acute setting.[21] CFS was recorded across all age bands allowing process measures to be compared across the entire dataset. CFS is not validated as tool to predict clinical outcomes in younger cohorts, but CFS was not employed for this purpose in our study; CFS was used to define a group of patients who may have complex care needs leading to different care processes during the provision of acute care. The presence of a geriatric syndrome was recorded as a dichotomous variable if a fall, delirium, new immobility or incontinence were identified by the admitting medical team during the process of clinical evaluation.[22] NEWS2 values were used as a proxy for illness severity. The first NEWS2 value obtained on arrival to hospital was recorded. The NEWS2 value was banded into 3 risk categories (NEWS2 $\leq$4, NEWS2 5 or 6, NEWS2 $\geq$7) reflecting national risk thresholds.[23]

Outcome variables

Outcome variables were based on the Society for Acute Medicine (SAM) clinical quality indicators.[24] The clinical quality indicators specify all patients should be assessed by a competent clinical decision maker within 4 h of arrival to hospital. A clinically competent decision maker was defined as any tier 1 clinician or above as described by the Royal College of Physicians guidance on safe medical staffing.[25,26] The term encompasses doctors and non-medical members of the clinical team, such as advanced clinical practitioners and physicians associates with the appropriate training and competencies to undertake this role. The indicator does not differentiate between initial assessment by the emergency medicine team or acute medical services. In addition, all patients should be reviewed by the admitting consultant physician or an appropriate specialty consultant physician within 6 h of admission to hospital if admitted within daytime working hours (08:00–20:00) or within 14 h of admission to hospital if admitted out of core working hours (20:00–08:00). Outcome variables were dichotomised based on whether the clinical quality standard was achieved.

Missing data

Missing data was handled using joint model multiple imputation under the assumption variables were missing at random.[27] A summary of all missing data is provided in the Supplementary Material. The imputation model preserved the hierarchical structure of the data, with hospital as a level 2 variable. All patient data could be attributed to a hospital and imputation was only necessary at the patient level. The imputation model used age, CFS, location prior to admission (home, residential care, nursing care), the presence of a geriatric syndrome, receipt of a social package of care, the presence of a community do-not-attempt resuscitation document, the presence of an advance care plan and prior hospital admission within 30 days, in addition to the covariates described in the primary analytical model. Plausible values were created using Monte-Carlo simulation. Convergence was checked to ensure acceptable variance within and between imputed datasets by visualisation of diagnostic trace plots and examining the potential scale reduction factor.[28] Five imputed datasets were created after a burn in period of 5000 iterations and 1000 iterations between imputed dataset creation. Analytic models were fitted to each imputed dataset separately and pooled in accordance with Rubins rules.[29] Analysis of the imputed dataset is presented as the primary analysis. In descriptive plots and tables, those with missing data are retained as a categorical variable. Multiple imputation was implemented using the jomo package in R statistical software (Version 4.1.2., Vienna. Austria).

Statistics

Multi-variable mixed effect logistic regression modelling was used to describe the relationship between CFS and geriatric syndromes and the outcome measures. It was anticipated that the CFS variable and geriatric syndrome variable would have considerable overlap. To avoid collinearity separate logistic regression models were specified with CFS and geriatric syndromes as predictors. A random intercept was used to represent hospital level variation. Arrival time and NEWS2 were included as covariates within the model.

During preliminary analysis it was clear that the patient population assessed in SDEC had different characteristics to those assessed in other clinical locations. To reflect this, separate multivariable regression models were specified to analyse the entire population and a sub-group excluding all patients assessed in SDEC. The prevalence of frailty and geriatric syndromes was low amongst patients assessed in SDEC. Descriptive analysis therefore focused on the

sub-group of patients assessed in locations other than SDEC.

A proportion of patients were not eligible for consultant review, primarily as they had been discharged by another member of the medical team. These patients were included in analysis relating to initial review but excluded from analysis relating to the timing of consultant review.

Statistical analysis was undertaken using R statistical software (version 4.1.2., Vienna. Austria).

Mixed effect models were implemented using the lme4 package and the ICC was calculated using the sjstats package. Fixed effect coefficients are reported as odds ratios (OR) with 95% confidence intervals. Intraclass correlation coefficient (ICC) was calculated using a latent variable approach.

Sensitivity analysis

The imputed model was compared with a model using case-wise deletion. Sensitivity analysis was conducted by imputing all missing geriatric syndrome variables as present or absent. Sensitivity analysis was not undertaken in relation to the CFS variable due to the wide confidence intervals around the estimated odds ratio.

Ethics

SAMBA is registered as a priority audit on the NHS England Quality Accounts list. All data is collected in the delivery of routine care. Participating sites register with the Society for Acute Medicine and follow local audit registration approval processes. Local Caldicot guardian approval is required to participate. No identifiable data is transferred from participating sites. Health Research Authority has been granted to allow secondary analysis on non-identifiable data (REC 21/HRA/4196).

Role of funding source

The database for SAMBA is funded by the Society for Acute Medicine. The funders had no role in study design, data collection, data analyses, interpretation or writing of the report.

Results

Patient characteristics

Patient level data were collected from 7248 unplanned emergency admissions referred to acute medical services in 152 hospitals. The mean number of patient records per hospital was 48 (SD 22). Patient characteristics and details relating to location of assessment and outcome stratified by CFS are provided in Table 1 and by geriatric syndrome in Table 2. A total of 3604 (49.7%) patients were ≥70 years of age. The proportion of patients ≥70 years of varied between 7.6% and 97.1% at the hospital level. CFS was recorded in 5238 (72.3%). CSF was missing in 874 (24.2%) patients ≥70 years of age and 1136 (31.2%) patients <70 years of age. Complete CFS data was provided in 48 (31.7%) hospitals and CFS was not recorded in any of the submitted patient level data from 7 (4.6%) hospitals. The rate of missingness of the CFS variable was greater than 50% in 34 (22.5%) hospitals. The geriatric syndrome variable was recorded in 6896 (95.1%). The geriatric syndrome variable was missing in 98 (2.7%) of patients ≥70 years of age. A summary of missing variables and the multiple imputation process is provided in the Supplementary Material.

Assessment times in the complete cohort

In multivariate regression including all patients irrespective of location of assessment (including assessments in SDEC), patients with mild, moderate and severe frailty were less likely to be assessed within 4 h of arrival (adjusted OR, mild 79, 95% CI 0.68–0.96, moderate 0.67 95% CI 0.53–0.84, severe, 0.75 95% CI 0.58–0.96, terminally ill 0.59 95% CI 0.23–1.43) and less likely to be achieve the clinical quality indicator for consultant review (adjusted OR, mild 0.69 95% CI 0.58–0.83, moderate 0.55 95% CI 0.44–0.70, severe 0.54 95% CI 0.41–0.69, terminally ill 0.76 95% CI 0.42–1.5). Patients with geriatric syndromes were also less likely to be assessed within 4 h of arrival (adjusted OR 0.66 95% CI 0.56–0.76) or by a consultant within the recommended time frame (adjusted OR 0.45 95% CI 0.39–0.51).

Same day emergency care

Assessment was undertaken in a SDEC area in 1736 (24.0%) emergency medical admissions. Of those assessed in SDEC, 1708 (98.4%) had a NEWS ≤4, 192 (11.3%) had a CFS ≥4 and 66 (4.0%) had a geriatric syndrome. A summary of the proportion of patients with a NEWS ≤4 assessed in SDEC stratified by CFS and presence of a geriatric syndrome is provided in Fig. 1. Patients assessed in SDEC areas were significantly more likely to have an initial assessment within 4 h of arrival (OR 2.36, 95% CI 1.99–2.83) and significantly more likely to achieve the clinical quality indicator for consultant review (OR 9.23, 95% CI 7.4–11.6). Subsequent analysis was restricted to 5848 (80.6%) patients assessed in locations other than SDEC of which 5148 (88.2%) were assessed in the ED and 602 (10.3%) in AMU.

Time to initial assessment

Initial assessment within 4 h of arrival to hospital occurred in 4462 (76.4%) patients. The proportion of patients assessed within 4-h ranged from 26.5% to 100% at the hospital level.

The proportion of patients initially assessed within 4 h increased incrementally with NEWS2.

(NEWS2 ≤4, 70.4% (95% CI 69.1–71.7), NEWS 5–6 85.9 95% CI 82.6–88.9, NEWS ≥7 93.5 95% CI 90.8–95.6).

Characteristic	N	Overall, N = 7248[a]	CFS				p-value[b]
			Robust, N = 2885[a]	Mild to moderate, N = 1863[a]	Severe, N = 490[a]	Missing, N = 2010[a]	
Female	7248	3749 (52%)	1463 (51%)	962 (52%)	279 (57%)	1045 (52%)	
Age	7248						<0.001
<40		1054 (15%)	666 (23%)	23 (1.2%)	12 (2.4%)	353 (18%)	
40–49		572 (7.9%)	352 (12%)	34 (1.8%)	8 (1.6%)	178 (8.9%)	
50–59		900 (12%)	464 (16%)	118 (6.3%)	25 (5.1%)	293 (15%)	
60–69		1117 (15%)	515 (18%)	251 (13%)	40 (8.2%)	311 (15%)	
70–79		1535 (21%)	536 (19%)	505 (27%)	100 (20%)	394 (20%)	
80–89		1584 (22%)	308 (11%)	701 (38%)	205 (42%)	370 (18%)	
≥90		486 (6.7%)	44 (1.5%)	231 (12%)	100 (20%)	111 (5.5%)	
Location prior to arrival	7242						<0.001
Home		6575 (91%)	2771 (96%)	1636 (88%)	316 (64%)	1852 (92%)	
Sheltered accommodation		132 (1.8%)	30 (1.0%)	59 (3.2%)	13 (2.7%)	30 (1.5%)	
Residential care		164 (2.3%)	4 (0.1%)	61 (3.3%)	64 (13%)	35 (1.7%)	
Nursing home		196 (2.7%)	10 (0.3%)	62 (3.3%)	83 (17%)	41 (2.0%)	
Other		175 (2.4%)	70 (2.4%)	45 (2.4%)	14 (2.9%)	46 (2.3%)	
Unknown		6	0	0	0	6	
Receipt of social package of care	7244	1126 (16%)	77 (2.7%)	491 (26%)	313 (64%)	245 (12%)	<0.001
Unknown		4	0	1	0	3	
Presence of geriatric syndrome	6896	1514 (22%)	200 (7.2%)	715 (39%)	256 (53%)	343 (19%)	<0.001
Unknown		352	109	42	8	193	
NEWS on arrival	7218						<0.001
NEWS2 ≤4		6274 (87%)	2648 (92%)	1512 (81%)	358 (73%)	1756 (88%)	
NEWS2 5 or 6		500 (6.9%)	142 (4.9%)	178 (9.6%)	57 (12%)	123 (6.2%)	
NEWS2 ≥7		444 (6.2%)	91 (3.2%)	171 (9.2%)	74 (15%)	108 (5.4%)	
Unknown		30	4	2	1	23	
Time of arrival	7245						<0.001
08:00–11:59		1685 (23%)	737 (26%)	379 (20%)	87 (18%)	482 (24%)	
12:00–15:59		2026 (28%)	797 (28%)	519 (28%)	116 (24%)	594 (30%)	
16:00–19:59		1613 (22%)	646 (22%)	432 (23%)	117 (24%)	418 (21%)	
20:00–23:59		845 (12%)	289 (10%)	261 (14%)	75 (15%)	220 (11%)	
00:00–07:59		1076 (15%)	415 (14%)	272 (15%)	95 (19%)	294 (15%)	
Unknown		3	1	0	0	2	
Location of initial clinical assessment	7241						<0.001
ED		5158 (71%)	1799 (62%)	1497 (80%)	431 (88%)	1431 (71%)	
AMU		602 (8.3%)	274 (9.5%)	183 (9.8%)	44 (9.0%)	101 (5.0%)	
SDEC		1399 (19%)	779 (27%)	158 (8.5%)	8 (1.6%)	454 (23%)	
Other		82 (1.1%)	33 (1.1%)	25 (1.3%)	7 (1.4%)	17 (0.8%)	
Unknown		7	0	0	0	7	
Initial clinical assessment within 4 h	7236	5696 (79%)	2357 (82%)	1422 (76%)	375 (77%)	1542 (77%)	<0.001
Unknown		12	1	1	0	10	
Assessment by medicine within 4 h	7204	3497 (49%)	1577 (55%)	790 (43%)	206 (42%)	924 (47%)	<0.001
Unknown		44	13	7	0	24	
Assessment by medicine within 12 h	7204	6395 (89%)	2644 (92%)	1622 (87%)	431 (88%)	1698 (85%)	<0.001
Unknown		44	13	7	0	24	
Consultant assessment within SAM threshold	6128	3044 (50%)	1264 (56%)	804 (47%)	207 (44%)	769 (46%)	<0.001
Unknown		1120	617	134	18	351	
Outcome at 14 days	7187						
Discharged without overnight stay		2067 (29%)	1173 (41%)	244 (13%)	32 (6.6%)	618 (31%)	
Discharged ≥1 overnight stay		3629 (50%)	1347 (47%)	1032 (56%)	253 (52%)	997 (50%)	
Continuous hospital admission		912 (13%)	178 (6.2%)	380 (21%)	128 (26%)	226 (11%)	
Readmitted		67 (0.9%)	19 (0.7%)	21 (1.1%)	6 (1.2%)	21 (1.1%)	

(Table 1 continues on next page)

Characteristic	N	Overall, N = 7248[a]	CFS				p-value[b]
			Robust, N = 2885[a]	Mild to moderate, N = 1863[a]	Severe, N = 490[a]	Missing, N = 2010a	
(Continued from previous page)							
Self-discharged		116 (1.6%)	56 (2.0%)	20 (1.1%)	0 (0%)	40 (2.0%)	
Died		243 (3.4%)	31 (1.1%)	99 (5.3%)	54 (11%)	59 (3.0%)	
Transferred to other health care facility		153 (2.1%)	49 (1.7%)	55 (3.0%)	15 (3.1%)	34 (1.7%)	
Unknown		61	32	12	2	15	

Legend: Table provides a summary of the complete dataset stratified by CFS. A separate column is provided for records where Clinical Frailty Scale was missing. National Early Warning Score 2 (NEWS2) Clinical Frailty Scale (CFS). [a]n (%). [b]Pearson's Chi-squared test.

Table 1: **Clinical characteristics and outcomes stratified by Clinical Frailty Scale.**

A total of 4061 (82.9%) had a NEWS2 ≤4 on arrival. The proportion of patients assessed within 4 h of arrival was higher in those categorised as robust using CFS (robust 77.2 95% CI 75.2–79.1, moderate 68.9% 95% CI 64.1–73.5, severe 70.3 95% 65.1–75.2). There was no statistical difference in the proportion of patients assessed within 4 h between CFS groups in those with a NEWS2 5-6 or ≥ NEWS 7. In the patient group with a NEWS ≤4, the proportion of patients initially assessed within 4 h was significantly lower in the presence of a geriatric syndrome (present, 67.9% 95% CI 65.2–70.5, absent 75.6% 95% CI 74.1–77.0). There was no statistical difference in the proportion of patients assessed within 4 h based on the presence of a geriatric syndrome in those with NEWS2 5-6 or ≥ NEWS 7.

In multi-variable regression, there was no statically significant association between CFS and initial assessment within 4 h (Table 3A). The presence of a geriatric syndrome was associated with a significant decrease in the odds of assessment within 4 h of arrival (adjusted OR 0.71, 95% CI 0.60–0.83) (Table 3B).

Time to consultant review

Consultant review was not undertaken in 517 (8.8%) patients, 344 (66.6%) were discharged prior to consultant review, 48 (9.3%) were referred to another speciality, 54 (10.4%) self-discharged prior to review and 14 (2.7%) were transferred directly to intensive care. The reason was unrecorded in 57 (11.0%) patients. Time to consultant review was recorded in 5331 (91.2%) patients.

Assessment by a consultant within the clinical quality indicator standard was achieved in 3044 (49.6%). Achievement of the target ranged from 11.3% to 100% at the hospital level. The 6-h consultant review target was achieved in 2344 (45.3%) patients arriving to hospital within core hours. The 14-h consultant review target was achieved in 700 (72.6%) patients arriving out of hours. Arriving to hospital between 16:00 and 19:59 was associated with a decrease in performance against the consultant assessment standard (Fig. 2).

The proportion of patients with moderate or severe frailty assessed within the consultant review standard was lower than in the robust group in those arriving in core hours (08:00–15:59) and out of hours (20:00–07:59). A similar pattern was present amongst those presenting in late afternoon (16:00–19:59) although the smaller sample size resulted in large confidence intervals (Fig. 2). The presence of a geriatric syndrome was associated with poorer performance against the consultant review clinical indicator across all arrival time-bands (Fig. 2B). The difference was most marked amongst patients arriving in core hours.

Analysis of consultant assessment time using narrower 2 h intervals suggested patients in the robust CFS group were overrepresented in shorter assessment time bands and underrepresented in longer assessment time bands relative to prevalence. This included the group assessed by a consultant over 24 h from arrival (Fig. 3A). Analysis of the relationship was complicated by the high proportion of missing data. Patients with a geriatric syndrome also appeared under-represented in shorter consultant assessment time bands and overrepresented in longer assessment time bands relative to prevalence (Fig. 3B).

In multi-variable regression, moderate frailty and severe frailty were associated with a statically significant decrease in the odd of achieving consultant review within the clinical quality indicator defined threshold (moderate, adjusted OR 0.75, 95% CI 0.59–0.94, severe adjusted OR 0.75 95% CI 0.58–0.96) (Table 4A).

The presence of a geriatric syndrome was also associated with a decreased odds of achieving the consultant review clinical quality indicator (adjusted OR 0.59, 95% CI 0.50–0.69) (Table 4B).

Sensitivity analysis

The association between geriatric syndrome and all reported process outcomes remained statistically significant in models using case-wise deletion to deal with missing data. To test the robustness of findings to extremes, geriatric syndrome was imputed as present and absent for all records where the value was missing. The fixed effect coefficient remained statistically significant against all process outcomes.

Characteristic	N	Overall, N = 7248[a]	Geriatric syndrome			p-value[b]
			Absent, N = 5382[a]	Present, N = 1514[a]	(missing), N = 352[a]	
Female	7248	3749 (52%)	2783 (52%)	800 (53%)	166 (47%)	0.3
Age	7248					<0.001
<40		1054 (15%)	958 (18%)	2 (0.1%)	94 (27%)	
40–49		572 (7.9%)	519 (9.6%)	8 (0.5%)	45 (13%)	
50–59		900 (12%)	805 (15%)	20 (1.3%)	75 (21%)	
60–69		1117 (15%)	939 (17%)	138 (9.1%)	40 (11%)	
70–79		1535 (21%)	1096 (20%)	402 (27%)	37 (11%)	
80–89		1584 (22%)	849 (16%)	685 (45%)	50 (14%)	
≥90		486 (6.7%)	216 (4.0%)	259 (17%)	11 (3.1%)	
CFS	5238					<0.001
Robust		2885 (55%)	2576 (66%)	200 (17%)	109 (69%)	
Mild to moderate		1863 (36%)	1106 (28%)	715 (61%)	42 (26%)	
Severe		490 (9.4%)	226 (5.8%)	256 (22%)	8 (5.0%)	
Unknown		2010	1474	343	193	
Location prior to arrival	7242					<0.001
Home		6575 (91%)	5016 (93%)	1235 (82%)	324 (94%)	
Sheltered accommodation		132 (1.8%)	80 (1.5%)	48 (3.2%)	4 (1.2%)	
Residential care		164 (2.3%)	69 (1.3%)	89 (5.9%)	6 (1.7%)	
Nursing home		196 (2.7%)	81 (1.5%)	111 (7.3%)	4 (1.2%)	
Other		175 (2.4%)	136 (2.5%)	31 (2.0%)	8 (2.3%)	
Unknown		6	0	0	6	
Receipt of social package of care	7244	1126 (16%)	495 (9.2%)	603 (40%)	28 (8.0%)	<0.001
Unknown		4	1	0	3	
NEWS on arrival	7218					<0.001
NEWS2 ≤4		6274 (87%)	4702 (88%)	1265 (84%)	307 (90%)	
NEWS2 5 or 6		500 (6.9%)	362 (6.7%)	112 (7.4%)	26 (7.6%)	
NEWS2 ≥7		444 (6.2%)	304 (5.7%)	130 (8.6%)	10 (2.9%)	
Unknown		30	14	7	9	
Time of arrival	7245					<0.001
08:00–11:59		1685 (23%)	1325 (25%)	279 (18%)	81 (23%)	
12:00–15:59		2026 (28%)	1533 (28%)	394 (26%)	99 (28%)	
16:00–19:59		1613 (22%)	1207 (22%)	328 (22%)	78 (22%)	
20:00–23:59		845 (12%)	558 (10%)	242 (16%)	45 (13%)	
00:00–07:59		1076 (15%)	759 (14%)	270 (18%)	47 (13%)	
Unknown		3	0	1	2	
Location of initial clinical assessment	7241					
ED		5158 (71%)	3605 (67%)	1325 (88%)	228 (66%)	
AMU		602 (8.3%)	453 (8.4%)	125 (8.3%)	24 (7.0%)	
SDEC		1399 (19%)	1263 (23%)	52 (3.4%)	84 (24%)	
Other		82 (1.1%)	61 (1.1%)	12 (0.8%)	9 (2.6%)	
Unknown		7	0	0	7	
Initial clinical assessment within 4 h	7236	5696 (79%)	4329 (80%)	1083 (72%)	284 (83%)	<0.001
Unknown		12	2	0	10	
Assessment by medicine within 4 h	7204	3497 (49%)	2816 (53%)	503 (33%)	178 (53%)	<0.001
Unknown		44	26	3	15	
Assessment by medicine within 12 h	7204	6395 (89%)	4854 (91%)	1233 (82%)	308 (91%)	<0.001
Unknown		44	26	3	15	
Consultant assessment within SAM threshold	6128	3044 (50%)	2323 (53%)	565 (39%)	156 (53%)	<0.001
Unknown		1120	1016	47	57	
Outcome at 14 days	7187					
Discharged without overnight stay		2067 (29%)	1878 (35%)	105 (7.0%)	84 (26%)	
Discharged ≥1 overnight stay		3629 (50%)	2610 (49%)	839 (56%)	180 (55%)	

(Table 2 continues on next page)

Characteristic	N	Overall, N = 7248[a]	Geriatric syndrome			p-value[b]
			Absent, N = 5382[a]	Present, N = 1514[a]	(missing), N = 352[a]	
(Continued from previous page)						
Continuous hospital admission		912 (13%)	485 (9.1%)	392 (26%)	35 (11%)	
Readmitted		67 (0.9%)	47 (0.9%)	14 (0.9%)	6 (1.8%)	
Self-discharged		116 (1.6%)	100 (1.9%)	7 (0.5%)	9 (2.8%)	
Died		243 (3.4%)	137 (2.6%)	98 (6.5%)	8 (2.4%)	
Transferred to other health care facility		153 (2.1%)	95 (1.8%)	53 (3.5%)	5 (1.5%)	
Unknown		61	30	6	25	

Legend: Table provides a summary of the complete dataset stratified by the presence of geriatric syndrome. A separate column is provided for records where the presence of a geriatric syndrome is unrecorded. National Early Warning Score 2 (NEWS2) Clinical Frailty Scale (CFS). [a]n (%). [b]Fisher's exact test; Pearson's Chi-squared test.

Table 2: **Clinical characteristics and outcomes stratified by the presence of a geriatric syndrome.**

Discussion

Our analysis points to inequalities in the acute care system related to the care of people with frailty following emergency medical admission. Clinical prioritisation is a core function of the acute care pathway. There is a wealth of evidence that links frailty and geriatric syndromes to adverse outcomes in the acute setting.[6,30,31] Older people with frailty often have atypical presentations of acute-illness which may mask the underlying diagnosis.[32] Geriatric syndromes may be a

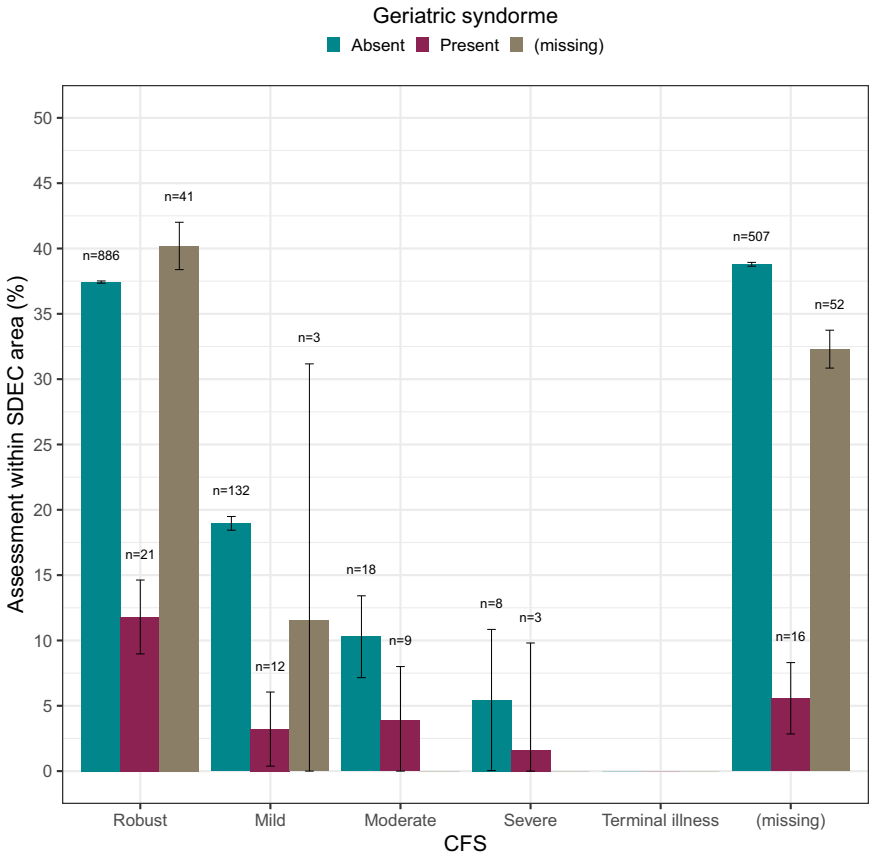

Fig. 1: Bar plot demonstrating proportion of patients with NEWS2 ≤4 assessed within SDEC areas stratified by CFS and the presence of a geriatric syndrome. Legend: Plotted using all patients with NEWS2 ≤4 (n = 6274, 86.6%). Missing CFS and geriatric syndrome variables tabulated separately. n = demonstrates the sample size in each strata. Error bars represent 95% confidence intervals. National Early Warning Score 2 (NEWS2) Clinical Frailty Scale (CFS). Same day emergency care (SDEC).

(A) Dependent variable: Initial assessment <4 h

Predictor	Estimate (OR)	Std.Error	CI 2.5%	CI 97.5%	p value
(Intercept)	7.3	0.12	5.9	9.4	<0.001
CFS 4-5 (ref: CFS 1-3)	0.85	0.9	0.70	1.02	0.07
CFS 6	0.69	0.12	0.53	1.01	0.06
CFS 7-8	0.84	0.14	0.64	1.12	0.23
CFS 9	0.66	0.41	0.29	1.53	0.33
NEWS2 5-6 (ref: NEWS ≤4)	2.4	0.15	1.8	3.2	<0.001
NEWS2 ≥7	6.3	0.21	4.2	9.6	<0.001
Arrival time (ref 08:00–19:59)					
20:00–0759	0.36	0.09	0.30	0.42	<0.001
16:00–19:59	0.56	0.09	0.47	0.66	<0.001
Adjusted ICC	0.23				

(B) Dependent variable: Initial assessment <4 h

Predictor	Estimate (OR)	Std.Error	CI 2.5%	CI 97.5%	p value
(Intercept)	7.4	1.12			
Geriatric syndrome (Present)	0.71	1.08	0.60	0.83	<0.001
NEWS2 5-6 (ref: NEWS ≤4)	2.32	1.16	1.74	3.08	<0.001
NEWS2 ≥7	6.10	1.23	4.06	9.17	<0.001
Arrival time (ref 08:00–19:59)					
20:00–0759	0.34	1.09	0.30	0.42	<0.001
16:00–19:59	0.56	1.1	0.46	0.67	<0.001
Adjusted ICC	0.25				

Legend: Output from mixed effect logistic regression models. All patients assessed in SDEC areas excluded. Fixed effect co-efficient and corresponding 95% confidence intervals are reported as odds ratios (OR). Intraclass correlation coefficient (ICC).

Table 3: **Output from mixed effect regression models of initial assessment.**

manifestation of serious systemic illness and deranged physiological observation may not provide accurate risk stratification in this group.[33,34] Our finding suggest the acute care pathway is not adequately calibrated to these risks.

Patients with frailty or presenting with geriatric syndromes are less likely to have an initial assessment within 4 h of arrival. They are also less likely to reviewed by a consultant within time thresholds defined by national clinical quality standards. This is partly explained by differential access to SDEC areas. The clinical processes utilised in SDEC are materially different to those employed in the assessment of patients assessed through the ED. Those assessed via SDEC are significantly more likely to be assessed within recommend time thresholds. Patients with frailty defined by CFS and with geriatric syndromes were less likely to be assessed in SDEC areas. SDEC care pathways typically employ selection processes based on the expectation of discharge without the need for overnight stay which may act to systematically disadvantage those with complex care needs. The SDEC environment may not be suitably adapted or resourced to provide additional nursing support to those with functional dependency. Several scoring systems used to identify patients suitable for SDEC include age and other factors which correlate with frailty as predictors.[35] This may drive lower rates of utilisation of SDEC pathways in the context of frailty.

Older people living with frailty are well placed to benefit from SDEC models. The inpatient setting may contribute to the risk of deconditioning, falls and delirium associated with acute illness. The application of SDEC principles to avoid hospital admission when clinically appropriate may reduce exposure to these risks. National guidance on SDEC delivery explicitly states that those with complex social or functional needs should not be arbitrarily excluded from SDEC pathways.[14] This does not reflect the reality of care delivery observed in our study.

Analysis excluding patients assessed via SDEC pathways demonstrated differences in care process related to frailty and geriatric syndromes. The presence of a geriatric syndrome was associated with lower rates of initial assessment within 4 h in multivariable regression. Although a higher proportion of patients classified as robust using CFS were assessed within 4 h of arrival in the low risk NEWS2 group, there was no statistically significant relationship between CFS and initial assessment in the multivariable regression model. A longitudinal study in Scotland using routinely collected health-care data suggested older people were less likely to be assessed within 4 h or arrival to ED.[36] Our finding suggest clinical prioritisation is influenced

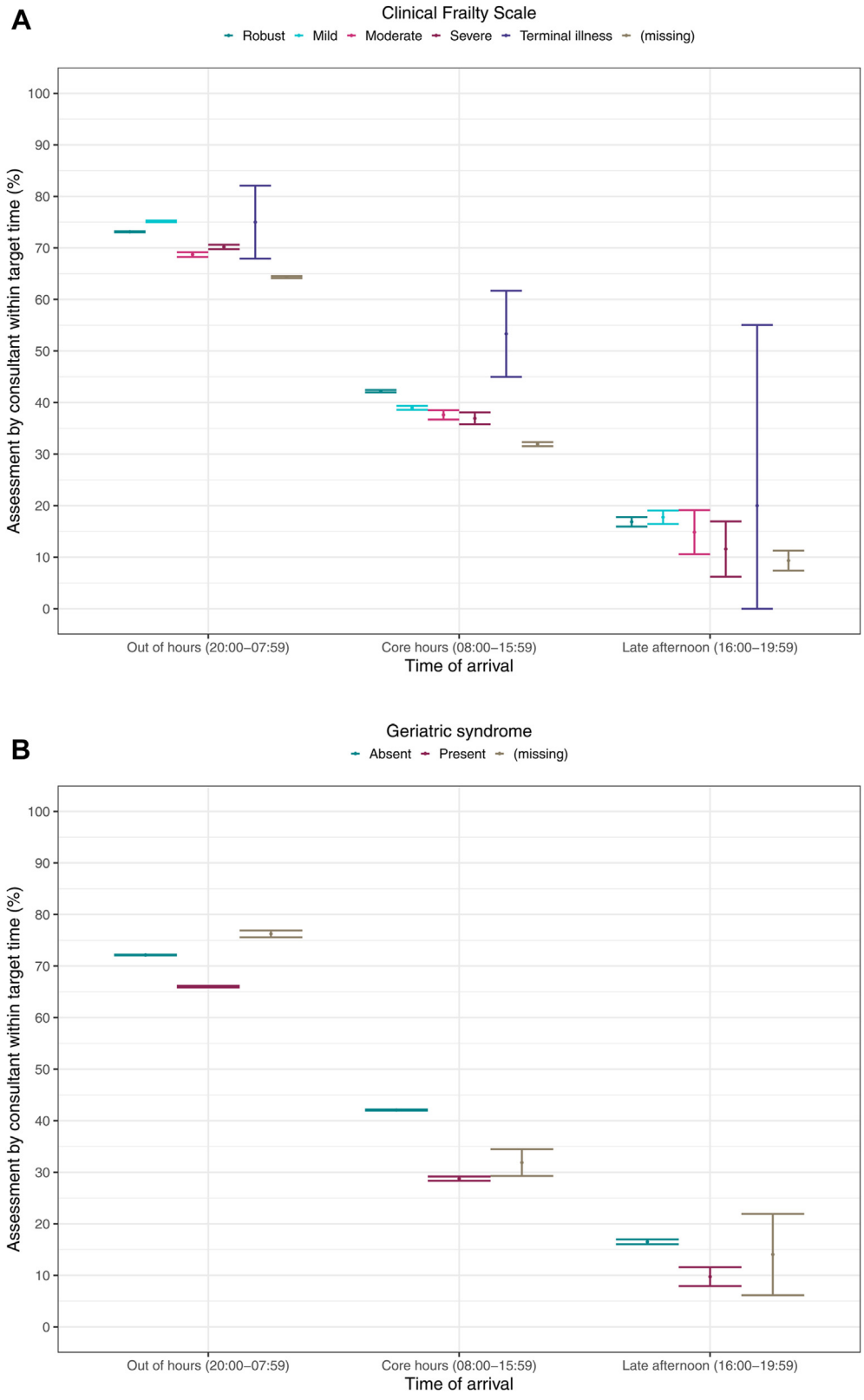

Fig. 2: Proportion of patients assessed within the clinical quality indicator for consultant review stratified by arrival time. A: Clinical Frailty Scale: B Geriatric syndrome. Legend: Arrival time is presented on the x axis. Proportion of patients assessed by a consultant within the relevant time threshold is represented on the y axis. Those with missing CFS and geriatric syndrome variables are retained (coloured wheat). Error bars represent 95% confidence intervals. Clinical Frailty Scale (CFS).

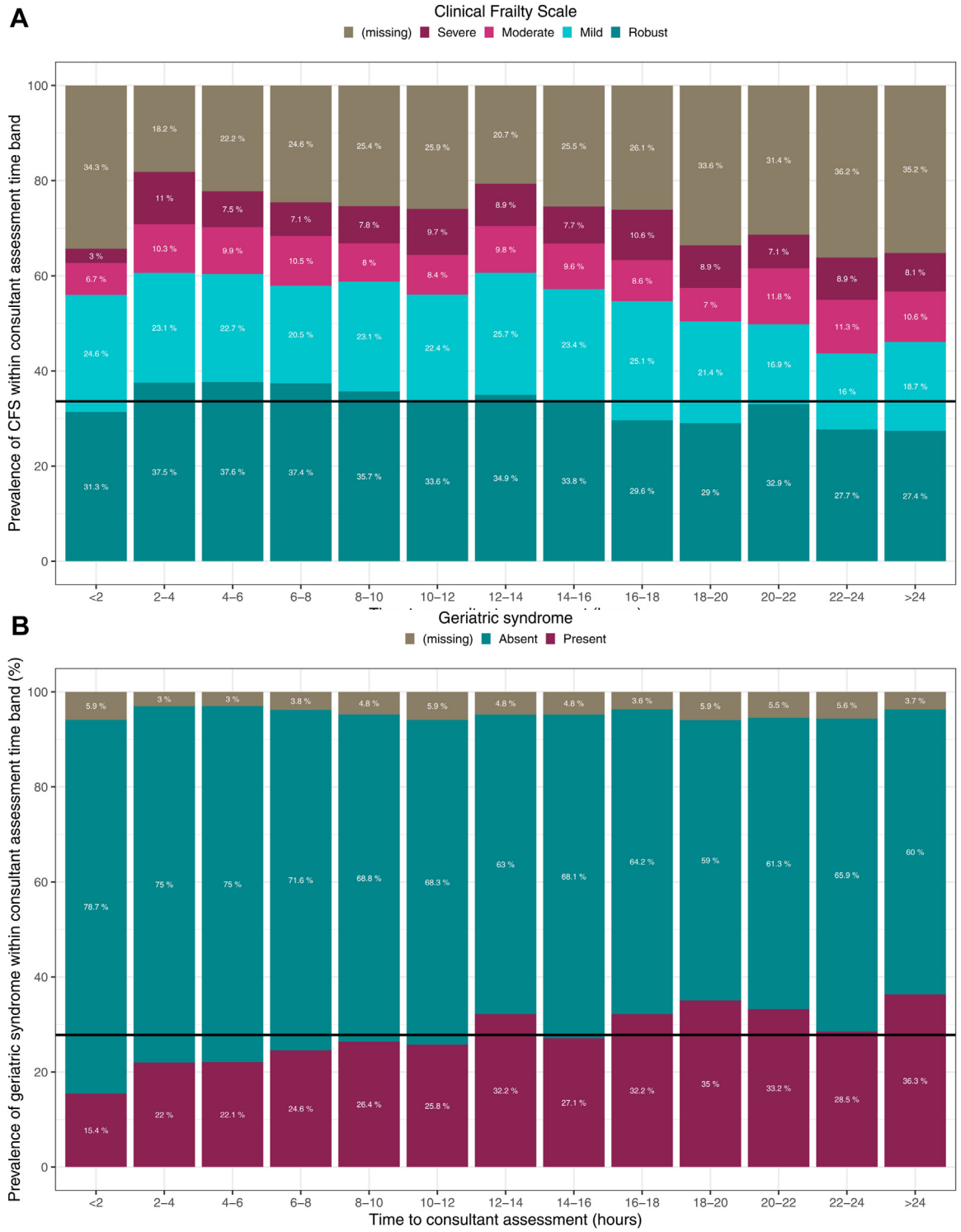

Fig. 3: Distribution of frailty and geriatric syndromes within 2-hour consultant assessment time bands. A. Stratified by CFS. B stratified by the presence of geriatric syndromes. Legend: Consultant assessment time is represented on the x-axis in 2 hour time bands. A separate band is provided for assessments over 24 hours. Missing values are wheat coloured and located at the top of each bar. The black horizontal line represents the population prevalence of the robust CFS group (33.6%) and presence of geriatric syndromes (27.8%). Clinical Frailty Scale (CFS).

(A) Dependent variable: Consultant assessment within clinical quality indicator time threshold

Predictor	Estimate (OR)	Std.Error	CI 2.5%	CI 97.5%	p value
(Intercept)	0.65	0.11	0.52	0.79	<0.001
CFS 4-5 (ref: CFS 1-3)	0.93	0.01	0.76	1.14	0.47
CFS 6	0.75	0.12	0.59	0.94	0.01
CFS 7-8	0.75	0.13	0.58	0.96	0.02
CFS 9	1.20	0.36	0.59	2.40	0.61
NEWS2 5-6 (ref: NEWS ≤4)	1.16	0.12	0.92	1.46	0.22
NEWS2 ≥7	1.58	0.13	1.24	2.02	<0.001
Arrival time (ref 08:00–19:59)					
20:00–0759	5.1	0.08	4.39	5.99	<0.001
16:00–19:59	0.24	0.10	0.20	0.29	<0.001
Adjusted ICC	0.22				

(B) Dependent variable: Consultant assessment within clinical quality indicator time threshold

Predictor	Estimate (OR)	Std.Error	CI 2.5%	CI 97.5%	p value
(Intercept)	0.68	0.10	0.56	0.83	<0.001
Geriatric syndrome (ref: Absent)	0.59	0.08	0.50	0.69	<0.001
NEWS2 5-6 (ref: NEWS ≤4)	1.11	0.12	0.89	1.40	0.39
NEWS2 ≥7	1.54	0.13	1.20	1.97	<0.001
Arrival time (ref 08:00–19:59)					
20:00–0759	5.25	0.08	4.49	6.14	<0.001
16:00–19:59	0.24	0.10	0.19	0.29	<0.001
Adjusted ICC	0.24				

Legend: Output from mixed effect logistic regression models. All patients assessed in SDEC areas excluded. Fixed effect co-efficient and corresponding 95% confidence intervals are reported as odds ratios (OR). Intraclass correlation coefficient (ICC).

Table 4: **Output from mixed effect regression models of consultant assessment.**

more by the presenting complaint rather than the degree of pre-existing functional impairment. It is possible that patients with falls or new onset delirium are perceived as less likely to benefit from earlier intervention than patient presenting with other acute illness syndromes such as chest pain or breathlessness. The magnitude of the observed effect suggests geriatric syndromes play an important role in determining the acute care response at the system level.

Moderate and severe frailty and the presence of a geriatric syndrome were associated with poorer performance against the consultant assessment clinical quality indicator. The reasons for this association are unclear. Performance against the consultant review metric is closely related to arrival time. The number of non-elective medical admission rises from 07:00 to reach a plateau between 15:00 and 00:00 then and falls rapidly to a nadir in the early morning.[37] Acute care services are typically organised around a morning ward round, during which consultant numbers are highest, followed by more limited consultant provision in the afternoon and evening. Resident consultant cover overnight is rare. The pattern of emergency admissions and consultant presence leads to a mismatch between demand and supply at certain times of day. During this period consultant review is likely to be selective. The acute care system is currently operating at or close to maximal capacity. This creates a powerful incentive to facilitate the safe discharge of lower acuity patients without overnight stay. Frailty or the presence of a geriatric syndromes should prompt multi-dimensional assessment to address the functional and social consequences of acute illness, this frequently requires the acquisition of collateral history and input from a multidisciplinary team. This added complexity may influence priortisation independently of clinical risk in a system that depends on admission avoidance to maintain operational performance.

This is the first study to show a clear association between frailty and clinical process outcomes in acute care. More than half of all acute hospitals in the UK participated allowing a reasonable assessment of acute care delivery at the system level. Hospital participation is voluntary creating the potential for sampling bias. It is not possible to ascertain whether patient level data were submitted from all eligible emergency admissions occurring during the study period.

SAMBA relies on a team of local clinicians to undertake data collection. This allows data-collection at scale but increases the risk of ascertainment bias, particularly in relation to recording of CFS and the presence of geriatric syndromes. Instructions were provided to data-collectors on how to record these variables, but no specific training was provided. The study

design did not allow quantification of inter-observer variability. There may have been systematic differences in the measurement of these variables between both individuals and hospitals. A geriatric syndrome was recorded as present if any of the pre-defined conditions were identified during the clinical evaluation by the admitting medical team. It is plausible that some geriatric syndromes were undetected during clinical review. The prevalence of geriatric syndromes may have been underestimated as a result.

CFS and the presence of a geriatric syndrome were incompletely recorded. The imputation model contained variables associated with frailty such as age, receipt of social package or care and residence in intuitional care allowing plausible values for missing CFS to be assigned. The results in relation to the presence of geriatric syndromes were robust to sensitivity analysis using extreme values suggesting missingness did not materially affect our findings. The high level of missisingess in the CFS variable and wide confidence intervals around the estimates of association between CFS and consultant review mean the results should be interpreted with caution.

The range of clinical and operational variables collected to adjust for confounding were limited. Unmeasured variables such as diagnosis, comorbidity and biochemical severity of illness create a risk of bias due to residual confounding.

The use of single-day of care methodology affect the precision estimates relative to a longitudinal approach. This is more likely to affect inference related to performance at the hospital level than in analysis based on aggregated data at the system level. We used appropriate statistical methods to account for hierarchal data clustering in both analytical and imputation models.

Contributors

All authors (T.K, C.A, T.C, C.S, M.H, VK, E.S, DL) contributed to the design of the study, interpretation of the data, and approved the final manuscript. T.K wrote the main manuscript, conducted primary analysis and created all figures. T.K and C.A verified the underlying data. All authors approved the final version of the manuscript.

Data sharing statement

The data that support the findings of this study are available from the Society for Acute Medicine, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the Society for Acute Medicine (contact the national SAMBA lead administrator@acutemedicine.org.uk).

Declaration of interests

ES has obtained research grants with the Medical Research Council, Health Data Research UK and National Institute for Health and Care Research. ES has conducted consultancy work for Gilead and honoraria from the European Respiratory Society to deliver a conference lecture. DSL is president of the Hospital at Home Society (unpaid position in professional medical society). MH is a co-applicant on successful National Institute for Health and Care Research grants. MH received honoraria for developing an online learning package on the unconscious patient.

Acknowledgements

The authors would like to thank all those that contributed to local data collection. The database for SAMBA is funded by the Society for Acute Medicine. This study was also supported by the NIHR Applied Research Collaboration (ARC) West Midlands and NIHR Oxford Biomedical Research Centre (BRC) through salary support to DSL. CA is supported by an NIHR Academic Clinical Lectureship. The views expressed are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.eclinm.2023.102278.

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