

Association of the Clinical Frailty Scale (CFS) with hospital outcomes

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Summary

Background: the Clinical Frailty Scale (CFS) was validated as a predictor of adverse outcomes in community-dwelling older people. In our hospital, the use of the CFS in emergency admissions of people aged ≥ 75 years was introduced under the Commissioning for Quality and Innovation payment framework.

Aim: we retrospectively studied the association of the CFS with patient characteristics and outcomes.

Design: retrospective observational study in a large tertiary university National Health Service hospital in England.

Methods: the CFS was correlated with transfer to specialist Geriatric ward, length of stay (LOS), in-patient mortality, and 30-day readmission rate.

Results: between 1st August 2013 and 31st July 2014, there were 11271 emergency admission episodes of people aged ≥ 75 years (all specialties), corresponding to 7532 unique patients (first admissions); of those, 5764 had the CFS measured by the admitting team (81% of them within 72 hours of admission). After adjustment for age, gender, Charlson comorbidity index, and history of dementia and/or current cognitive concern, the CFS was an independent predictor of in-patient mortality (OR = 1.60, 95% CI: 1.48 – 1.74, $P < 0.001$), transfer to Geriatric ward (OR = 1.33, 95% CI: 1.24 – 1.42, $P < 0.001$), and LOS ≥ 10 days (OR = 1.19, 95% CI: 1.14 – 1.23, $P < 0.001$). The CFS was not a multivariate predictor of 30-day readmission.

Conclusions: the CFS may help predict in-patient mortality and target specialist geriatric resources within the hospital. Usual hospital metrics such as mortality and LOS should take into account measurable patient complexity.

Key words

Frail Elderly

Geriatric Assessment

Hospital Medicine

Clinical Frailty Scale

Validation Studies

Introduction

Frailty is a state of vulnerability to poor resolution of homeostasis after a stressor event and is a consequence of cumulative decline in many physiological systems during a lifetime.¹ The Clinical Frailty Scale (CFS) is a measure of frailty based on clinical judgement. A validation study of the CFS in community-dwelling older people showed that it performed better than measures of cognition, function or comorbidity in assessing risk for death.² A revised 9-point CFS was released for research and educational purposes (http://geriatricresearch.medicine.dal.ca/clinical_frailty_scale.htm).

In using the CFS, the assessor makes a judgment about the degree of a person's frailty based on information from a formal clinical assessment³ that takes into account cognition, mobility, function and co-morbidities to assign a frailty level from 1 (very fit) to 9 (terminally ill, life expectancy < 6 months). Despite its reported validity in research studies, additional data is still required on the feasibility and validity of the CFS in real clinical settings.⁴

When older adults present to the acute hospital with a health problem, health professionals routinely conduct clinical assessments that may facilitate the scoring of patients on the CFS. An easy-to-understand summary measure of the level of frailty may predict outcomes and help tailor hospital services to the biologically heterogeneous population of older people.⁵ Indeed, it has been argued that patients' frailty should be the focus for the allocation of geriatric beds.^{6,7}

The use of the CFS in admissions of people aged ≥ 75 years was introduced in our centre under the Commissioning for Quality and Innovation (CQUIN) payment framework (http://www.institute.nhs.uk/commissioning/pct_portal/cquin.html). We retrospectively

investigated the association of the CFS with patient characteristics and outcomes in a large tertiary university National Health Service (NHS) acute hospital in England.

Methods

Setting. In our centre, there is a common assessment pathway for all patients presenting as an emergency.⁸ Specialist Emergency Assessment Units (EAUs) operate next to the Emergency Department (ED) and the Clinical Decision Unit (CDU).

During the study period (1st August 2013 to 31st July 2014), the specialist bed base of the Department of Medicine for the Elderly (DME) consisted of four ‘core’ geriatric wards. Core DME wards specialise in ward-based Comprehensive Geriatric Assessment (CGA) and each of them is supported by dedicated nursing, physiotherapy, occupational therapy, and social work teams, as well as by readily available input from speech and language therapy, clinical nutrition, psychogeriatric and palliative care teams. Formal multidisciplinary team meetings occur at least twice weekly. A new specialist DME EAU, the Frailty and Acute Medicine for the Elderly (FAME) unit, was set up at the beginning of March 2014 and became fully operational in June 2014 (<http://www.cuh.org.uk/news/accident-emergency/cuh-unit-for-frail-and-elderly-patients-now-fully-operational>). While admission to FAME is through the emergency pathway, admission to core DME wards can occur from FAME (i.e. within-DME transfer) and other in-patient specialty areas (through a dedicated specialist nurse-led geriatric consultation service: SAFE), as well as via the emergency pathway.

Sample. We analysed all emergency admission episodes of people aged ≥ 75 years (all specialties) between 1st August 2013 and 31st July 2014. The data was obtained electronically via the Trust’s official information systems.

Patients’ characteristics and outcomes. The following variables were extracted from the Trust’s official information systems:

- Age and gender.
- Admission and discharge ward and specialty.
- Clinical Frailty Scale. The CQUIN required that ‘all patients aged 75 years or over admitted to the Trust, via the emergency pathway, are to be screened for frailty using the CFS within 72 hours of admission’. A section with the CFS and its scoring instructions (as per http://geriatricresearch.medicine.dal.ca/clinical_frailty_scale.htm) was included in the standard medical admission proforma. The admitting junior doctor usually scored the CFS on the proforma, but it could also be completed by ED nurses or by SAFE nurses. Training on CFS scoring was provided to medical and nursing staff on induction and at regular educational meetings.
- Known history of dementia and/or current cognitive concern (yes or no): the admitting team collected this information under a parallel CQUIN scheme. Current cognitive concern included possible undiagnosed dementia or delirium.
- Charlson comorbidity index (CCI)⁹ (without age adjustment) based on ICD-10 discharge codes.
- Length of stay (LOS, days). Prolonged LOS was defined as LOS \geq 10 days.
- In-patient mortality (%).
- 30-day readmission rate (%).

Statistical analyses. They were conducted with IBM[®] SPSS[®] Statistics (version 20). Only first admission episodes were included. Descriptives were given as count (with percentage) or mean (with standard deviation: SD). Comparisons between two groups were conducted with the Chi-square test (dichotomous variables) or the independent samples Mann-Whitney U test (continuous variables). To statistically test for linear trends across CFS categories, we used the two-sided Chi-square test for trend (dichotomous variables) or the two-sided Spearman’s

rho correlation coefficient (continuous variables); to control the latter trends for age, we used multivariate linear regression (with the CFS as dependent variable) or the two-tailed partial correlation procedure, respectively. To investigate multivariate predictors of a dichotomous outcome, we used the multivariate binary logistic regression procedure. In order to compare the ability of individual variables as mortality predictors, we computed receiver-operating characteristic (ROC) curves, and calculated their areas under the curve (AUC) with 95% confidence intervals (CI).

Ethics approval. This Service Evaluation Audit was registered with our centre's Safety and Quality Support Department (Project register number 3962). Formal confirmation was received that approval from the Ethics Committee was not required.

Declaration of sources of funding

The rights to the CFS for clinical use were purchased by the hospital from a company called Videx Inc. Funding for this Service Evaluation Audit was not required.

Results

Between 1st August 2013 and 31st July 2014, there were 11271 emergency admission episodes of people aged ≥ 75 years (all specialties), corresponding to 7532 unique patients (first admissions); their mean age (SD) was 84.3 (5.9) years, and 56.3% were women. Of the 7532 first admissions, 5764 (76.5%) had CFS information. The CFS was completed within 72 hours of admission in 81.1% of cases.

Table 1 shows the correlations of the CFS with patient characteristics and outcomes, and includes a comparison between those with and without CFS data. Results suggest that the 23.5% of patients without CFS information were younger, less comorbid, less cognitively impaired, less likely to be admitted to core geriatric beds, and had shorter LOS and higher mortality. The results of the multivariate analysis in Table 2 suggest that older age, higher comorbidity and the presence of dementia and/or cognitive concern were associated with a lower likelihood of the CFS being missing.

As Table 1 shows, there were statistically significant age-independent gradients across CFS categories (in the expected direction) in all the characteristics and outcomes studied. Table 2 shows the results of multivariate analyses investigating the CFS as an independent predictor of outcomes after adjustment for age, gender, CCI and history of dementia and/or current cognitive concern. The odds ratios suggest that the strongest effect of the CFS was as an independent predictor of in-patient death (OR = 1.60, 95% CI: 1.48 – 1.74, $P < 0.001$), followed by transfer into core DME ward (OR = 1.33, 95% CI: 1.24 – 1.42, $P < 0.001$).

As Table 2 shows, the CFS was also a weaker independent predictor of prolonged LOS (OR = 1.19, 95% CI: 1.14 – 1.23, $P < 0.001$), as was history of dementia and/or current cognitive

concern independently of the CFS. Dementia had the largest OR for prolonged LOS in this analysis (OR = 1.42, 95% CI: 1.24 – 1.63, $P < 0.001$); again, dementia was the independent predictor with the largest odds ratio for transfer into core DME ward (OR = 1.71, 95% CI: 1.39 – 2.10, $P < 0.001$).

Over the study period, DME discharged 2066 first admission episodes, of which 1413 were discharged from core DME wards. Of the 1413 core DME discharges, 896 were initially admitted to core DME wards, and 517 came from elsewhere. Among the latter, 100 were within-DME transfers (e.g. from FAME or CDU), 339 had been initially admitted to General Medicine or Acute Medicine beds, 55 to beds under other medical specialties and 23 to surgical beds.

As Table 2 shows, neither the CFS nor dementia were significant multivariate predictors of 30-day readmission. CCI was a very weak predictor (OR = 1.03, 95% CI: 1.01 – 1.06, $P = 0.016$).

The associations of the CFS with in-patient mortality, prolonged LOS and 30-day readmission *vis-à-vis* CCI, age and cognitive concerns are further represented in Figures 1 and 2 using AUCs. Consistently with the results from the multiple regression analyses, the CFS was strongest at the prediction of in-patient death (AUC = 0.72, 95% CI: 0.69 – 0.75, $P < 0.001$) and transfer to core DME wards from non-DME beds (AUC = 0.68, 95% CI: 0.66 – 0.71, $P < 0.001$). Based on AUC analyses, the prediction for other outcomes was much weaker.

Discussion

The present retrospective audit investigated the association of the CFS with patient characteristics and outcomes in a ‘real world’ large tertiary university NHS acute hospital. Our results suggest that the CFS had reasonable accuracy as an independent predictor of in-patient mortality and transfer into specialist DME beds. The CFS was a weaker independent predictor of prolonged LOS, and did not significantly predict 30-day readmission. For DME transfer and prolonged LOS, additional information on history of dementia and/or current cognitive concern may be of complementary value to the CFS.

In that light, the resources provided to our centre by the CQUIN scheme to screen for frailty and dementia appear to be well placed, and the derived information could serve as a practical focus to target specialist geriatric resources within the hospital, epitomising the importance of *all* clinician’s perspective in identifying those needs.¹⁰

To our knowledge, our study is the first to relate the CFS to the allocation of geriatric beds in an NHS ‘real world’ scenario. In our retrospective observational study, hospital Geriatric Medicine appears reaffirmed as the recognised specialty for the management of dementia, delirium, frailty and multi-morbidity in the very old. Our results highlight the significant role of core specialist Geriatric Medicine wards in absorbing complex cases, especially from our general medical colleagues. In that light, one may argue that typical hospital activity metrics such as LOS and mortality should take into account such measurable patient complexity.

The main limitations of our study are its observational, retrospective design and that the information available on the Trust’s database did not include important potential confounders of patient outcomes such as acute illness severity. This may be of particular relevance, since a

recent study in the acute hospital setting showed that the CFS had a significant direct correlation with the National Early Warning Score.¹¹ Therefore, it is possible that the admission frailty level and the pre-admission (baseline) level could differ considerably. In that light, the comparison of patient outcomes for patients admitted to core DME wards versus those not admitted to DME wards relative to their admission CFS score (or between patients admitted via FAME versus ED or other EAUs) would need to be done prospectively and taking into account validated markers of acute illness severity, and it was beyond the scope of this audit.

In our sample, 23.5% of patients had missing CFS information. Judging by their higher mortality rates, it is possible that those with no CFS information presented with greater acute illness severity. In support of this hypothesis, we found high rates of missing CFS in patients admitted to the following areas: neurosciences critical care unit (70.2%), intensive care unit (48.3%), theatres (35.7%), general surgery (32.8%), and oncology (32.0%). On the other hand, patients admitted to planned short stay areas such as the CDU and the medical short stay unit also had relatively high proportions of missing CFS (41.1% and 30.2%, respectively). It is possible that clinicians may feel less inclined to complete the CFS in situations of extreme high acuity or when the planned LOS is short (e.g. less than 72 hours). Unfortunately the audit database did not include specific information on exactly when, and by whom, the CFS was completed.

As regards the association of the CFS with in-patient mortality, our results are consistent with previous studies¹²⁻¹⁶, including previous findings that the risk of mortality was defined more precisely by the CFS than by the burden of co-morbidity.¹⁷ In that light, it has been said that comorbidity indexes in older people should not be interpreted in isolation, but within the

context of a CGA including age-related preclinical dysfunctions, frailty measures, and functional, mental and psychosocial issues.¹⁸ Indeed, despite the potential value of frailty and dementia screening in the hospital, to date it is only in-hospital CGA that has strong evidence for increasing the patients' likelihood of being alive and in their own home at up to twelve months;¹⁹ and CGA is, of course, the 'core' business of 'core' geriatric wards.

Regarding LOS, our results are consistent with previous studies recognising that frailty (measured by the CFS) is a confounder of LOS in acute medical admissions.^{12,20,21} Our results are also consistent with the known fact that dementia and delirium prolong hospitalisation.²²

With our finding that the CFS was not a significant multivariate predictor of 30-day readmission, we echo the results of a previous study conducted within the NHS with older Acute Medical Unit patients.²³ It is possible that frailty may not be a good predictor of readmission because it predicts post-discharge mortality²⁴; perhaps, comorbidities with high exacerbation rates but relatively lower mortality may be more predictive of readmissions. As in our study, others have found the CCI to be predictive of readmissions²⁵; however, this finding has not been universal²⁶ and more research is needed to establish predictors of early hospital readmission in older people.

There have been concerns that an inter-observer discrepancy in CFS scoring may occur between health professionals.²⁷ However, a previous study investigated the inter-rater reliability of the CFS between clinicians in 107 community-dwelling older adults aged 75 years and above, finding a 'substantial agreement' with a weighted kappa coefficient of 0.76 (95% CI: 0.68 – 0.85).²⁸ Another study reported a CFS weighted kappa of 0.92.²⁹ Despite

that, a limitation of our study is that the CFS was not systematically repeated at discharge or after the 72-hour target, in order to determine test-retest reliability. Our study was an audit of a ‘real life’ clinical programme as opposed to a formal research exercise.

In conclusion, the CFS had reasonable accuracy for implementation in a ‘real life’ NHS acute hospital scenario, and may help capture complexity, grade risk and target specialist geriatric resources within the hospital. The collection of both frailty and dementia information may be complementary in achieving those goals. Further studies will be needed to evaluate existing NHS initiatives^{20, 30}, including ours, incorporating the use of the CFS in the acute hospital setting.

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Conflict of interest

None declared.

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Table 1. Correlations of the Clinical Frailty Scale (CFS) with patient characteristics and outcomes, and analysis of CFS missing data.

	CFS-1 (n=90)	CFS-2 (n=333)	CFS-3 (n=1051)	CFS-4 (n=1024)	CFS-5 (n=930)	CFS-6 (n=1276)	CFS-7 (n=818)	CFS-8 (n=174)	CFS-9 (n=68)	<i>P</i> for trend	Age- adjusted <i>P</i> for trend	CFS not missing (n=5764)	CFS missing (n=1768)	<i>P</i> for difference (CFS missing vs. not missing)
Mean age (SD)	80.2 (4.7)	81.0 (4.5)	81.8 (4.9)	83.7 (5.3)	85.4 (5.7)	86.7 (5.8)	86.3 (6.0)	86.6 (6.4)	84.9 (6.3)	<0.001 ^Σ	-	84.6 (5.9)	83.3 (5.8)	<0.001 ^μ
Female sex (%)	43.3	45.9	48.3	51.3	62.8	62.7	62.1	58.0	33.8	<0.001 ^{χ²}	<0.001 ^ψ	56.2	56.5	0.838 ^{χ²}
Mean CCI (SD)	1.0 (1.3)	1.5 (2.2)	1.9 (2.5)	2.3 (2.5)	2.7 (2.7)	3.1 (2.8)	3.5 (2.9)	3.7 (3.1)	5.2 (3.5)	<0.001 ^Σ	<0.001 ^φ	2.7 (2.8)	2.4 (2.6)	<0.001 ^μ
Dementia and/or concern (%)	2.2	4.8	6.2	12.5	21.2	38.2	50.7	44.8	25.0	<0.001 ^{χ²}	<0.001 ^ψ	24.4	14.5	<0.001 ^{χ²}
Admission ward: core geriatric (%)	8.9	7.5	7.9	12.6	14.0	21.0	23.2	16.1	17.6	<0.001 ^{χ²}	<0.001 ^ψ	15.1	7.4	<0.001 ^{χ²}
Discharge ward: core geriatric (%)	7.8	8.1	9.5	16.2	20.8	31.3	36.1	28.7	26.5	<0.001 ^{χ²}	<0.001 ^ψ	21.8	8.9	<0.001 ^{χ²}
Admitted from non-core and discharged from core geriatric ward (%)	0.0	1.2	2.5	5.3	7.8	12.7	14.5	14.4	10.3	<0.001 ^{χ²}	<0.001 ^ψ	8.2	2.7	<0.001 ^{χ²}
Mean LOS in days (SD)	4.1 (7.3)	5.3 (8.8)	6.8 (10.9)	7.9 (10.3)	9.9 (11.3)	12.2 (13.7)	12.7 (14.7)	12.0 (18.0)	9.6 (9.2)	<0.001 ^Σ	<0.001 ^φ	9.6 (12.5)	5.7 (9.7)	<0.001 ^μ
In-patient death (%)	2.2	1.5	1.8	2.9	4.4	6.4	11.0	24.1	30.9	<0.001 ^{χ²}	<0.001 ^ψ	5.8	8.8	<0.001 ^{χ²}
Readmission within 30 days (%)	4.4	7.2	11.4	13.2	14.5	15.4	14.4	9.8	13.2	<0.001 ^{χ²}	0.006 ^ψ	13.2	12.4	0.403 ^{χ²}

CCI: Charlson Comorbidity Index; SD: standard deviation; ^Σ 2-sided Spearman's rho correlation coefficient; ^μ Independent samples Mann-Whitney U test; ^{χ²} Chi-square test for linear trend (2-sided); ^ψ Multivariate linear regression (CFS: dependent variable); ^{χ²} Chi-square test (2-sided); ^φ Partial correlation (2-tailed).

Table 2. Multivariable predictors of outcomes.

	B	Standard Error	P	Odds Ratio (OR)	95% CI for OR	
					Lower	Upper
Missing CFS (multivariable n=7528)						
Age	-0.03	0.01	<0.001	0.97	0.96	0.98
Gender	0.09	0.06	0.115	1.09	0.98	1.22
CCI	-0.02	0.01	0.045	0.98	0.96	1.00
Dementia and/or concern	-0.54	0.08	<0.001	0.59	0.50	0.68
Transfer into core DME ward (multivariable n=5763)						
Age	0.04	0.01	<0.001	1.04	1.02	1.06
Gender	0.15	0.10	0.150	1.16	0.95	1.42
CCI	0.03	0.02	0.057	1.03	1.00	1.07
Dementia and/or concern	0.53	0.11	<0.001	1.71	1.39	2.10
CFS	0.28	0.04	<0.001	1.33	1.24	1.42
Prolonged LOS (multivariable n=5763)						
Age	0.03	0.01	<0.001	1.03	1.02	1.04
Gender	0.06	0.06	0.297	1.06	0.95	1.20
CCI	0.06	0.01	<0.001	1.06	1.04	1.08
Dementia and/or concern	0.35	0.07	<0.001	1.42	1.24	1.63
CFS	0.17	0.02	<0.001	1.19	1.14	1.23
In-patient death (multivariable n=5763)						
Age	0.03	0.01	0.001	1.03	1.01	1.05
Gender	-0.45	0.12	<0.001	0.63	0.50	0.80
CCI	0.14	0.02	<0.001	1.16	1.12	1.20
Dementia and/or concern	-0.41	0.13	0.002	0.66	0.51	0.86
CFS	0.47	0.04	<0.001	1.60	1.48	1.74
30-day readmission (multivariable n=5763)						
Age	0.02	0.01	0.027	1.02	1.00	1.03
Gender	-0.05	0.08	0.557	0.95	0.82	1.12
CCI	0.03	0.01	0.016	1.03	1.01	1.06
Dementia and/or concern	0.12	0.09	0.216	1.12	0.93	1.35
CFS	0.04	0.03	0.101	1.04	0.99	1.10

CFS: Clinical Frailty Scale; CCI: Charlson Comorbidity Index; LOS: length of stay.

Figure 1. ROC curves for the prediction of in-patient mortality. Areas under the curve (AUC) with 95% confidence intervals were: CFS: 0.72 (0.69 – 0.75, $P < 0.001$), Charlson Comorbidity score: 0.67 (0.64 – 0.70, $P < 0.001$), age: 0.59 (0.56 – 0.62, $P < 0.001$), history of dementia and/or current cognitive concern: 0.53 (0.50 – 0.56, $P = 0.076$).

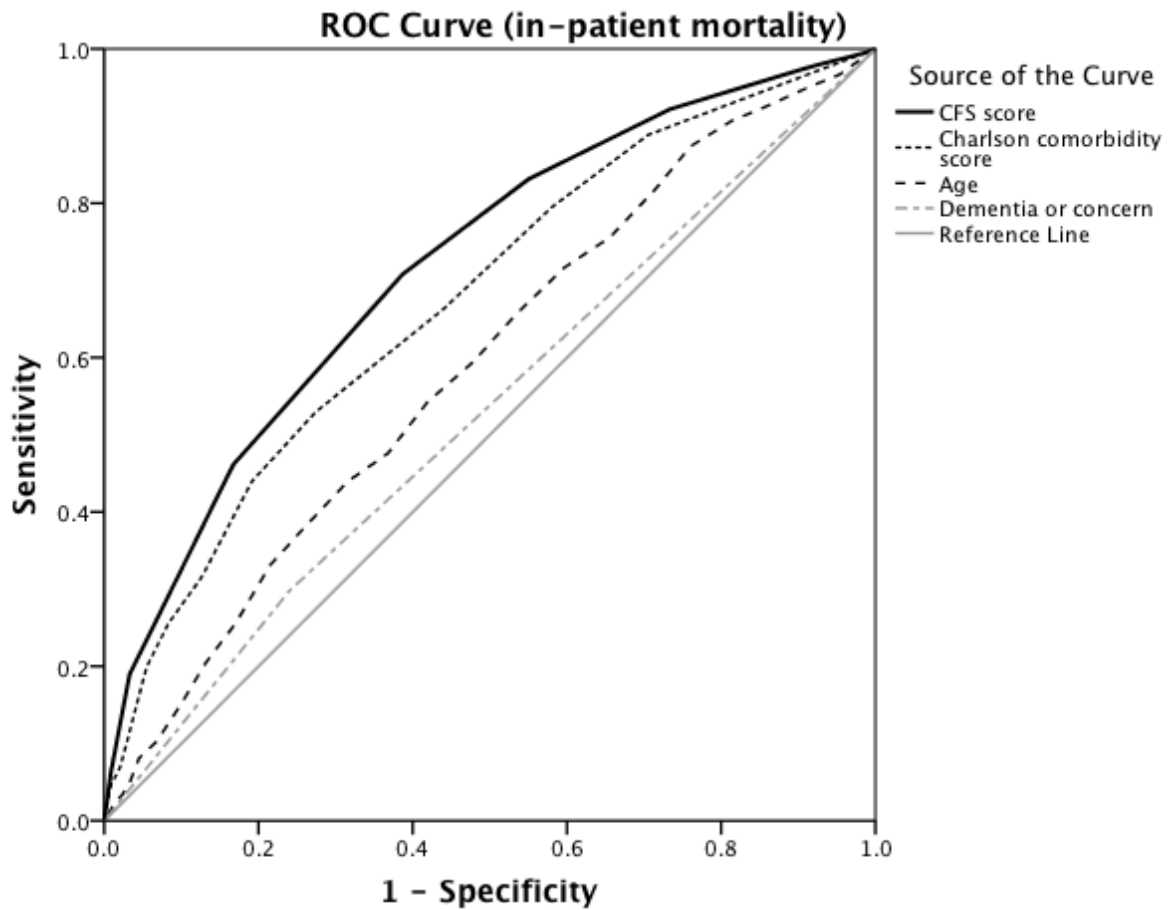


Figure 2. ROC curves for the prediction of transfer into core DME ward (from non-DME ward), LOS ≥ 10 days and 30-day readmission. Areas under the curve (AUC) with 95% confidence intervals for DME transfer were: CFS: 0.68 (0.66 – 0.71, $P < 0.001$), Charlson comorbidity score: 0.59 (0.56 – 0.62, $P < 0.001$), age: 0.62 (0.59 – 0.65, $P < 0.001$), history of dementia and/or current cognitive concern: 0.62 (0.59 – 0.64, $P < 0.001$). AUCs for LOS ≥ 10 days were: CFS: 0.62 (0.61 – 0.64, $P < 0.001$), Charlson Comorbidity score: 0.58 (0.56 – 0.59, $P < 0.001$), age: 0.58 (0.56 – 0.60, $P < 0.001$), history of dementia and/or current cognitive concern: 0.57 (0.55 – 0.59, $P < 0.001$). AUCs for 30-day readmission were: CFS: 0.54 (0.52 – 0.56, $P < 0.001$), Charlson Comorbidity score: 0.54 (0.52 – 0.56, $P < 0.001$), age: 0.54 (0.51 – 0.56, $P = 0.002$), history of dementia and/or current cognitive concern: 0.52 (0.50 – 0.55, $P = 0.029$).

