ORIGINAL RESEARCH

The Association of Geriatric Syndromes with Hospital Outcomes

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BACKGROUND: Frailty, history of dementia (HoD), and acute confusional states (ACS) are common in older patients admitted to hospital.

OBJECTIVE: To study the association of frailty (≥6 points in the Clinical Frailty Scale [CFS]), HoD, and ACS with hospital outcomes, controlling for age, gender, acute illness severity (measured by a Modified Early Warning Score in the emergency department), comorbidity (Charlson Comorbidity Index), and discharging specialty (general medicine, geriatric medicine, surgery).

DESIGN: Retrospective observational study.

SETTING: Large university hospital in England.

PATIENTS: We analyzed 8202 first nonelective inpatient episodes of people aged 75 years and older between October 2014 and October 2015.

MEASUREMENTS: The outcomes studied were prolonged length of stay (LOS ≥10 days), inpatient mortality, delayed discharge, institutionalization, and 30-day readmission. Statisti-

cal analyses were based on multivariate regression models.

RESULTS: Independently of controlling variables, prolonged LOS was predicted by CFS ≥6: odds ratio (OR) =1.55; 95% confidence interval [CI], 1.36-1.77; $P < 0.001$; HoD: OR = 2.16; 95% CI, 1.79-2.61; $P < 0.001$; and ACS: OR = 3.31; 95% CI, 2.64-4.15; $P < 0.001$. Inpatient mortality was predicted by CFS ≥6: OR = 2.29; 95% CI, 1.79-2.94; $P < 0.001$. Delayed discharge was predicted by CFS ≥6: OR = 1.46; 95% CI, 1.27-1.67; $P < 0.001$; HoD: OR = 2.17; 95% CI, 1.80-2.62; $P < 0.001$; and ACS: OR = 2.29; 95% CI: 1.83-2.85; $P < 0.001$. Institutionalization was predicted by CFS ≥6: OR = 2.56; 95% CI, 2.09-3.14; $P < 0.001$; HoD: OR = 2.51; 95% CI, 2.00-3.14; $P < 0.001$; and ACS: OR 1.93; 95% CI, 1.46-2.56; $P < 0.001$. Readmission was predicted by ACS: OR = 1.36; 95% CI, 1.09-1.71; $P = 0.006$.

CONCLUSIONS: Routine screening for frailty, HoD, and ACS in hospitals may aid the development of acute care pathways for older adults. *Journal of Hospital Medicine* 2017;12:83-89. © 2017 Society of Hospital Medicine

Geriatric syndromes are multifactorial health conditions that affect older people and include dementia, delirium, impaired mobility, falls, frailty, poor nutrition, weight loss, incontinence, and difficulties with activities of daily living.[1] These syndromes are highly prevalent among older patients admitted to acute-care hospitals[2,3] and often add complexity to the clinical status of hospitalized older adults with multiple comorbid conditions.[4] In the English National Health Service (NHS), the proportion of older people admitted to acute-care hospitals with geriatric syndromes has increased dramatically.[5]

The recognition and management of geriatric syndromes by hospitalists requires specific knowledge and skill sets.[6] However, geriatricians are a scarce resource in many settings, including the NHS. A challenge for service evaluation and research is the generally poor capture of information about geriatric syndromes compared to specific comorbidities in discharge summaries and hospital coding.[7] Steps are being taken in the NHS to address this issue, and in 2013 our center started the

routine collection of data on clinical frailty, history of dementia (HoD) and acute confusional state (ACS) in all patients 75 years or older admitted nonelectively to the hospital.[8]

The presence of geriatric syndromes in older inpatients is an important driver of adverse outcomes, particularly length of stay (LOS) and admission to institutional care.[9] However, acute illness severity (AIS) is also an important determinant of poor outcomes in the inpatient population and may drive disproportionate changes in health status in the most vulnerable.[10] Research studies with geriatric syndromes in acute settings have not been able to simultaneously consider AIS.[11] In addition, comorbidity is not always associated with an increased number of geriatric syndromes.[12]

We aimed to study the association of geriatric syndromes such as frailty, HoD and ACS that are measured in routine clinical care with hospital outcomes (prolonged LOS, inpatient mortality, delayed discharge, institutionalization, and 30-day readmission), while controlling for demographics (age, gender), AIS, comorbidity, and discharging specialty (general medicine, geriatric medicine, surgery).

PATIENTS AND METHODS
Study Design and Setting
This retrospective observational study was conducted in a large tertiary university hospital in England with 1000 acute beds receiving more than 102,000 visits to the emergency

TABLE 1. ED-MEWS: Components and Scoring

	Score						
Component	3	2	1	0	1	2	3
HR	<40	41-50	51-60	61-90	91-110	111-129	≥130
RR	≤6	7-8	-	9-14	15-20	21-29	≥30
SBP	≤70	71-80	81-100	101-180	-	≥181	-
AVPU	U	P	V	A			
GCS				15	14	9-13	≤8
Temp	-	<35.0	-	35.0-38.4	-	38.5-39.0	≥39.0

NOTE: ED-MEWS, Emergency Department Modified Early Warning Score; minimum score = 0 points, maximum score = 15 points. Abbreviations: AVPU, alert, responds to voice, responds to pain, unresponsive; GCS, Glasgow Coma Scale; HR, heart rate (beats per minute); RR: respiratory rate (per minute); SBP: systolic blood pressure (mm Hg); temp, body temperature (degrees Celsius).

department (ED) and admitting over 73,000 patients per year; among the latter, more than 12,000 are 75 years and older.

Sample

We analyzed all first nonelective inpatient episodes (ie, from ED admission to discharge) of people 75 years and older (all specialties) between the October 26, 2014 and the October 26, 2015. Data were obtained via the hospital's information systems following the implementation of a new electronic patient record on October 26, 2014.

Patients' Characteristics

The following anonymized variables were extracted:
- Age and gender
- AIS information is routinely collected in our ED using a Modified Early Warning Score (ED-MEWS). The components and scoring of ED-MEWS are shown in Table 1. Where more than 1 ED-MEWS was collected, the highest was used in the analyses.
- Charlson Comorbidity Index (CCI, without age adjustment).[13] The CCI is based on the discharge diagnoses, as coded according to WHO International Classification of Diseases, v 10 (ICD-10). The CCI was calculated retrospectively and would have not been available to clinicians early during the patients' admission.
- Clinical Frailty Scale (CFS). The scoring of CFS is based on a global assessment of patients' comorbidity symptoms, and their level of physical activity and dependency on activities of daily living, estimated to reflect the status immediately before the onset of the acute illness leading to hospitalization. The possible scores are: 1 (very fit), 2 (well), 3 (managing well), 4 (vulnerable), 5 (mildly frail), 6 (moderately frail), 7 (severely frail), 8 (very severely frail), and 9 (terminally ill) (http://geriatricresearch.medicine.dal.ca/clinical_frailty_scale.htm).[14] The use of the CFS in admissions of people 75 years and older was introduced in our center in 2013 under a local Commissioning for Quality and Innovation (CQUIN) scheme.[8] The CQUIN required that all patients 75 years and older admitted to the hospital, via the ED, be screened for frailty using the CFS within 72 hours of admission. The

admitting doctor usually scores the CFS on the electronic admission record, but it can also be completed by ED nurses or by nursing or therapy staff from the trust-wide Specialist Advice for the Frail Elderly team. Training on CFS scoring is provided to staff at a hiring orientation and at regular educational meetings. Permission to use CFS for clinical purposes was obtained from the principal investigator at Geriatric Medicine Research, Dalhousie University, Halifax, Canada.
- Cognitive variables were collected early during the admission in patients 75 years and older, thanks to a parallel local CQUIN scheme. The cognitive CQUIN variables are screening variables, not gold standard. The admission clerking is designed to clinically classify patients within 72 hours of admission into the following 3 mutually exclusive categories:
  ○ Known HoD (in the database: no = 0; yes = 1)
  ○ ACS, without HoD (in the database: no = 0; yes = 1)
  ○ Neither HoD nor ACS
- The cognitive CQUIN assessment does not intend to diagnose dementia in those who are not known to have it, but tries to separate the dementias that general practitioners (GPs) know from hospital-identified acute cognitive concerns that GPs may need to assess or investigate after discharge. The latter may include delirium and/or undiagnosed dementia.
- In our routine hospital practice, the initial cognitive assessment is performed by a clinician in the following fashion: if the patient is known to have dementia (ie, based on clinical history and/or chart review), the clinician selects the "known history of dementia" option in the admission navigator, and no further cognitive screening is conducted. If the patient has no known dementia, the clinician administers the 4-item Abbreviated Mental Test (AMT4): (1) age, (2) date of birth, (3) place, and (4) year, with impaired cognition indicated by an AMT4 of less than 4 and triggering the selection of "ACS without known HoD" option. If the AMT4 is normal, the clinician selects the "neither HoD nor ACS" option.
- Due to the service evaluation nature of our work, these measures could not be assessed for reliability within the electronic medical records system (eg, regarding sensitiv-

ity and specificity against a gold standard or inter-rater reliability).

- Discharged from geriatric medicine (no = 0; yes = 1). Every year, our hospital admits over 12,000 patients 75 years and older, of which 25% are managed by the Department of Medicine for the Elderly (DME). The DME specialist bed base consists of 5 core wards, which specialize in ward-based comprehensive geriatric assessment (CGA) and are 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, pharmacy and palliative care teams. Formal multidisciplinary team meetings occur at least twice weekly. A sixth specialist DME ward with a more acute perspective has been operational for 7 years; this ward was renamed the Frailty and Acute Medicine for the Elderly (FAME) ward in 2014 and has daily multidisciplinary team meetings. Although admission to FAME is through the ED, admission to core DME wards can occur from FAME (ie, within-DME transfer), via the ED, or from other inpatient specialty areas if older patients are perceived to be in high need of CGA after screening by the Specialist Advice for the Frail Elderly team. An audit in our center showed that up to 20% of patients discharged by DME were not initially admitted by DME, underscoring the significant role of core specialist DME wards in absorbing complex cases, especially from the general medical wards.[8]
- Discharged from general medicine (no = 0; yes = 1). In our setting, virtually all patients discharged by general medicine were first admitted by general medicine.[8]
- Discharged by a surgical specialty (no = 0; yes = 1)

Hospital Outcomes
The following anonymized variables were identified:
- LOS (days). Prolonged LOS was defined as 10 or more days (no = 0; yes = 1)
- Inpatient mortality (no = 0; yes = 1)
- Delayed discharge (no = 0; yes = 1). This was defined as the total LOS being at least 1 day longer than the LOS up to the last recorded clinically fit date. This date is used in NHS hospitals to indicate that the acute medical episode has finished and discharge-planning arrangements (often via social care providers) can commence.
- Institutionalization (no = 0; yes = 1). This was defined as the discharge destination being a care home, when a care home was not the usual place of residence.
- 30-day readmission (no = 0; yes = 1)

Statistical Analyses
Anonymized data were analyzed with IBM SPSS Statistics (v 22, Armonk, New York) software. Descriptive statistics were given as count (with percentage) or mean (with standard deviation).

To avoid potential problems with multicollinearity in the multivariate regression models, the correlations among the predictor variables were checked using a correlation matrix of 2-sided Spearman's *rho* correlation coefficients. Correlations of 0.50 or more were considered large.[15,16]

Because all outcomes in the study were binary, multivariate binary logistic regression models were computed. In these models, the odds ratio (OR) reflects the effect size of each predictor; 95% confidence intervals (CI) were requested for each OR. Predictors with $P < 0.01$ were considered as statistically significant. The classification performance of each logistic regression model was assessed calculating its area under the curve (AUC).

Sensitivity analyses were conducted after imputing missing data (SPSS multiple imputation procedure) and after fitting interaction terms between geriatric syndromes and discharge by geriatric medicine.

RESULTS
The initial database contained 12,282 nonelective admission and discharge episodes (all specialties) of patients 75 years and older between October 26, 2014 and October 26, 2015. Among those, 8202 (66.8%) were first episodes. Table 2 shows the sample descriptives, and Table 3 shows the breakdown of geriatric syndromes (single and multiple) in the total sample (n = 8282), including missing frailty data.

In the correlation matrix of 2-sided Spearman's *rho* correlation coefficients, no correlations with large-effect size were found to suggest issues with multicollinearity; the largest correlation coefficients were between age and CFS (*rho* = 0.35), HoD and CFS (*rho* = 0.32), and CCI and CFS (*rho* = 0.26).

The results of the multivariate regression models are shown in Table 4. The best performing models were the ones for inpatient mortality (AUC = 0.80), followed by institutionalization (AUC = 0.76), and prolonged LOS (AUC = 0.71). After full adjustment, clinical frailty was an independent predictor of prolonged LOS, inpatient mortality, delayed discharge, and institutionalization. HoD was an independent predictor of prolonged LOS, delayed discharge, and institutionalization; and ACS was an independent predictor of prolonged LOS, delayed discharge, institutionalization, and 30-day readmission (Table 4). Results did not significantly change in sensitivity analyses conducted after multiple imputation of missing data and after inclusion of interaction terms (see Supplemental Table 1 and Supplemental Table 2).

DISCUSSION
Our aim was to study the association of geriatric syndromes (measured in routine clinical care) with hospital outcomes. We found that geriatric syndromes such as clinical frailty, HoD, and ACS were strong independent predictors. Concerning prolonged LOS, delayed discharge, and institutionalization, geriatric syndromes had ORs that were greater than those of traditionally measured factors such as demographics, comorbidity and acute illness severity. Our findings add to the body of knowledge in this area because we

TABLE 2. Sample Descriptives (8202 First Admission and Discharge Episodes)

	% (n) or mean (range; SD)
Age, y	84.1 (75 to 105; 5.9)
Female gender	56.5% (4631)
ED-MEWS	2.9 (0 to 12; 1.8)
CCI	2.9 (0 to 23; 3.1)
CFS	4.8 (1 to 9; 1.7)
CFS 1: very fit	1.1% (92)
CFS 2: fit	4.6% (381)
CFS 3: managing well	14.1% (1159)
CFS 4: vulnerable	11.8% (968)
CFS 5: mildly frail	12.4% (1021)
CFS 6: moderately frail	16.1% (1324)
CFS 7: severely frail	9.0% (736)
CFS 8: very severely frail	2.1% (169)
CFS 9: terminally ill	0.6% (49)
CFS missing	28.1% (2303)
HoD	9.9% (812)
ACS	6.3% (519)
Discharge from general medicine	33.1% (2715)
Discharge from geriatric medicine	22.2% (1817)
Discharge from surgery	27.9% (2289)
LOS, d	8.9 (0 to 209; 12.7)
LOS ≥10 d	30.3% (2488)
Inpatient mortality	7.4% (604)
Delayed discharge	26.3% (2158)
Institutionalization	9.9% (809)
30-d readmission	29.8% (2447)

NOTE: Abbreviations: ACS, acute confusional state; CFS, Clinical Frailty Scale; CCI, Charlson Comorbidity Index; ED-MEWS, Emergency Department Modified Early Warning Score; HoD, history of dementia; LOS, length of stay; n, number; SD, standard deviation.

TABLE 3. Geriatric Syndromes (Single and Multiple) in Total Sample, Including Missing Frailty Data[a]

						Count
CFS ≥6	No (3621)	HoD	No (3493)	ACS	No	3332
					Yes	161
			Yes (128)	ACS	No	128
					Yes	0
	Yes (2278)	HoD	No (1742)	ACS	No	1490
					Yes	252
			Yes (536)	ACS	No	536
					Yes	0
	Missing (2303)	HoD	No (2155)	ACS	No	2049
					Yes	106
			Yes (148)	ACS	No	148
					Yes	0

[a]n = 8282.

NOTE: Abbreviations: ACS, acute confusional state; CFS, Clinical Frailty Scale; HoD, history of dementia.

tia.[25] Older people with cognitive impairment may have an increased risk of acquiring new geriatric syndromes during hospitalization, particularly if it is prolonged.[26] One study showed that the risk of poor functional recovery can be as high as 70% in complex delirious patients in hospital.[27] All too often, delirium is neither benign nor reversible, with a significant proportion of patients not experiencing restoration *ad integrum* of cognition and function.[28]

Our results are consistent with observations that geriatric syndromes are associated with higher risk of institutionalization.[29] It was interesting that female gender seemed to be an independent predictor of institutionalization, which is consistent with the results of a systematic review showing that the male-to-female ratio of admission rates ranged between 1 to 1.4 and 1 to 1.6.[30]

Discharge by general medicine appeared to be associated with a lower likelihood of prolonged LOS, and discharge by geriatric medicine seemed to be associated with a higher likelihood of delayed discharge and institutionalization. Unsurprisingly, geriatric medicine wards tend to absorb the most complex cases, often with complex discharge planning needs.[8] In that light, CGA in geriatric wards may not be associated with reduced LOS (and it is possible that the LOS of complex patients might have been higher in nongeriatric wards). In addition, inpatient CGA increases frail patients' likelihood of survival.[31]

Our study suggests that routinely collected metrics on frailty, HoD and ACS may be helpful to better adapt hospital care to the real requirements of aged people. The proportion of older people admitted to acute hospitals with geriatric syndromes continues to increase[5] and geriatricians are a scarce resource. It will be increasingly important to upskill nongeriatric hospitalists in the recognition and management of geriatric syndromes. Frail older people are becom-

accounted for the latter effects. Our experience shows that metrics on geriatric syndromes can be successfully collected in the routine hospital setting and add clear value to the prediction of operational outcomes. This may encourage other hospitals to do the same.

Our findings are consistent with suggestions that accounting for chronic conditions alone may be less informative than also accounting for the co-occurrence of geriatric syndromes.[17] The focus of CFS is on the pre-admission level of physical activity and dependency on activities of daily living, and poorer scores may confer vulnerability to adverse outcomes due to reduced physiological reserve and ability to withstand acute stressors.[18] Other studies have also found CFS to be a good predictor of inpatient outcomes,[19-22] and it has been recommended as a possible means to identify vulnerable older adults in acute-care settings.[23]

HoD and ACS had independent effects beyond frailty, particularly in prolonging LOS, delaying discharge, and requiring institutionalization. Dementia prolongs LOS,[24] and delirium prolongs hospitalization for persons with demen-

TABLE 4. Results of Multivariate Regression Models

Dependent variable: LOS ≥10 d (n = 5546); chi-square = 708.1; *P* < 0.001; AUC = 0.71)

	Unstandardized coefficients			95% CI for OR		
	B	Std. error	OR	Lower bound	Upper bound	*P*
Age	0.01	0.01	1.01	1.00	1.03	0.009
Gender	0.07	0.06	1.08	0.95	1.22	0.234
ED-MEWS	0.11	0.02	1.12	1.08	1.16	<0.001
CCI	0.09	0.01	1.09	1.07	1.11	<0.001
CFS ≥6	0.44	0.07	1.55	1.36	1.77	<0.001
HoD	0.77	0.10	2.16	1.79	2.61	<0.001
ACS	1.20	0.12	3.31	2.64	4.15	<0.001
Dc gen med	-0.87	0.09	0.42	0.35	0.51	<0.001
Dc geri med	0.00	0.10	1.00	0.83	1.21	0.995
Dc surgery	0.08	0.10	1.09	0.89	1.32	0.411

Dependent variable: inpatient mortality (n = 5546; chi-square = 447.7; *P* < 0.001; AUC = 0.80)

	B	Std. error	OR	95% CI for OR		*P*
Age	0.05	0.01	1.05	1.03	1.07	<0.001
Gender	-0.17	0.12	0.85	0.67	1.06	0.145
ED-MEWS	0.40	0.03	1.49	1.41	1.57	<0.001
CCI	0.15	0.02	1.17	1.13	1.20	<0.001
CFS ≥6	0.83	0.13	2.29	1.79	2.94	<0.001
HoD	-0.37	0.16	0.69	0.50	0.95	0.024
ACS	0.17	0.19	1.19	0.82	1.72	0.363
Dc gen med	0.22	0.18	1.24	0.88	1.75	0.222
Dc geri med	0.06	0.19	1.06	0.74	1.52	0.759
Dc surgery	0.07	0.22	1.07	0.70	1.65	0.746

Dependent variable: Delayed discharge (n = 4984; chi-square = 416.6; *P* < 0.001; AUC = 0.68)

	B	Std. error	OR	95% CI for OR		*P*
Age	0.03	0.01	1.03	1.02	1.05	<0.001
Gender	0.00	0.07	1.00	0.88	1.13	0.953
ED-MEWS	-0.03	0.02	0.98	0.94	1.01	0.182
CCI	0.03	0.01	1.03	1.00	1.05	0.018
CFS ≥6	0.38	0.07	1.46	1.27	1.67	<0.001
HoD	0.78	0.10	2.17	1.80	2.62	<0.001
ACS	0.83	0.11	2.29	1.83	2.85	<0.001
Dc gen med	-0.23	0.10	0.80	0.66	0.97	0.021
Dc geri med	0.36	0.10	1.44	1.18	1.75	<0.001
Dc surgery	-0.10	0.11	0.90	0.73	1.12	0.358

ing the core business of acute hospitals,[32] making geriatrics "too important to be left to geriatricians."[33] Therefore, easily collected metrics on geriatric syndromes may help nongeriatricians identify these syndromes and address them early during admission.

Our study has important limitations. Firstly, geriatric syndromes were not identified with gold-standard measures. For example, ACS in the absence of known dementia should be seen only as a surrogate for delirium. ACS as a proxy measure is likely to underestimate the diagnosis of delirium, be-

TABLE 4. Results of Multivariate Regression Models *(continued)*

Dependent variable: Discharge to Care Home (Institutionalization) (n = 5546; Chi-square = 473.5; *P* < 0.001; AUC = 0.76)

	B	Std. error	OR	95% CI for OR		*P*
Age	0.03	0.01	1.03	1.02	1.05	<0.001
Gender	0.34	0.10	1.40	1.16	1.69	<0.001
ED-MEWS	0.03	0.03	1.03	0.98	1.08	0.266
CCI	0.03	0.02	1.03	1.00	1.06	0.055
CFS ≥6	0.94	0.10	2.56	2.09	3.14	<0.001
HoD	0.92	0.11	2.51	2.00	3.14	<0.001
ACS	0.66	0.14	1.93	1.46	2.56	<0.001
Dc gen med	-0.02	0.16	0.98	0.71	1.34	0.884
Dc geri med	0.64	0.16	1.90	1.40	2.58	<0.001
Dc surgery	0.11	0.18	1.12	0.79	1.60	0.535

Dependent variable: 30-d readmission (n = 5546; Chi-square = 103.0; *P* < 0.001; AUC = 0.59)

	B	Std. error	OR	95% CI for OR		*P*
Age	0.02	0.01	1.02	1.01	1.03	0.001
Gender	-0.05	0.06	0.95	0.85	1.07	0.412
ED-MEWS	-0.06	0.02	0.94	0.91	0.98	0.001
CCI	0.05	0.01	1.06	1.04	1.08	<0.001
CFS ≥6	0.09	0.07	1.10	0.96	1.25	0.171
HoD	0.10	0.10	1.10	0.91	1.34	0.309
ACS	0.31	0.11	1.36	1.09	1.71	0.006
Dc gen med	0.19	0.09	1.21	1.01	1.44	0.041
Dc geri med	-0.03	0.10	0.97	0.80	1.17	0.737
Dc surgery	-0.22	0.11	0.80	0.66	0.99	0.037

NOTE: The reference category for gender is male (male = 0; female = 1). Abbreviations: ACS, acute confusional state; AUC, area under the curve; CFS, Clinical Frailty Scale; CCI, Charlson Comorbidity Index; CI, confidence interval; Dc, discharge; ED-MEWS, Emergency Department Modified Early Warning Score; Gen Med, General Medicine; Geri Med, Geriatric Medicine; HoD, history of dementia; LOS, length of stay; n, number; OR, odds ratio.

cause the hypoactive type is commonly missed without valid measures. In addition, a patient with delirium superimposed upon dementia would have been coded as a 'known dementia.' The geriatric syndromes' measures could not be assessed for reliability within the electronic medical records system (eg, regarding sensitivity and specificity against a gold standard, or interrater reliability).

About the potential limitations of CFS, there have been concerns that an interobserver discrepancy in CFS scoring may occur between health professionals. However, 1 study investigated the interrater reliability of CFS between clinicians in 107 community-dwelling older adults 75 years and older, finding a substantial agreement with a weighted κ coefficient of 0.76 (95% CI: 0.68 to 0.85).[34] Another study reported a CFS-weighted kappa of 0.92.[35] Another limitation of CFS in our center is the significant proportion of missing data (28%). As we have shown, missing CFS data are more frequent in situations of very high acuity (including in critical care or surgical areas) or in medical areas when the LOS was short (eg, less than 72 hours).[8] We tried to address this bias by performing multiple imputation for missing data, which showed similar results.

Another limitation of our study is that we treated geriatric syndromes and the other predictors in the models as independent variables. However, many of the factors may be interrelated, and they present simultaneously in many patients. Indeed, the bivariate correlation between CFS and HoD was of moderate strength, because worsening cognition should score higher on CFS according to the scoring protocol. As expected, there was also a medium-sized correlation between CFS and CCI. It has been suggested that physical and cognitive frailty may be more informative as a single complex phenotype.[36] Indeed, the problems of old age tend to come as a package.[37]

For 30-day readmission, the AUC of the model was small, suggesting the existence of unmeasured explanatory variables. For example, although our results agree that AIS and chronic illness predict readmission,[38] the latter still remains an elusive outcome, and a more accurate prediction may be attained by adding socioeconomic variables to models.[39]

Our study echoes the potential utility of incorporating common geriatric clinical features in routine clinical examination and disposition planning for older patients in acute settings.[40]

Hospitals may find it informative to undertake large-scale screening for geriatric syndromes including frailty, dementia, and delirium in all older adults admitted via the ED. When combined with other routinely collected variables such as demographics, AIS, and comorbidity data, this process may provide hospitals with information that will help define the acute needs of the local population and aid in the development of care pathways for the growing population of older adults.

Acknowledgments

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