Delirium in Older Emergency Department Patients Is an Independent Predictor of Hospital Length of Stay

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Abstract

Objectives: The consequences of delirium in the emergency department (ED) remain unclear. This study sought to determine if delirium in the ED was an independent predictor of prolonged hospital length of stay (LOS).

Methods: This prospective cohort study was conducted at a tertiary care, academic ED from May 2007 to August 2008. The study included English-speaking patients aged 65 and older who were in the ED for less than 12 hours at enrollment. Patients were excluded if they refused consent, were previously enrolled, were unable to follow simple commands at baseline, were comatose, or did not have a delirium assessment performed by the research staff. The Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) was used to determine delirium status. Patients who were discharged directly from the ED were considered to have a hospital LOS of 0 days. To determine if delirium in the ED was independently associated with time to discharge, Cox proportional hazard regression was performed adjusted for age, comorbidity burden, severity of illness, dementia, functional impairment, nursing home residence, and surgical procedure. A sensitivity analysis, which included admitted patients only, was also performed.

Results: A total of 628 patients met enrollment criteria. The median age was 75 years (interquartile range [IQR] = 69–81), 365 (58%) patients were female, 111 (18%) were nonwhite, 351 (56%) were admitted to the hospital, and 108 (17%) were delirious in the ED. Median LOS was 2 days (IQR = 0–5.5) for delirious ED patients and 1 day (IQR = 0–3) for nondelirious ED patients ($p < 0.001$). The hazard ratio (HR) of delirium for time to discharge was 0.71 (95% confidence interval [CI] = 0.57 to 0.89) after adjusting for confounders, and indicated that ED patients with delirium were more likely to have prolonged hospital LOS compared with those without delirium. For the sensitivity analysis, which included only hospitalized patients, the adjusted HR was 0.76 (95% CI = 0.58 to 0.99).

Conclusions: Delirium in older ED patients has negative consequences and is an independent predictor of prolonged hospitalizations.

ACADEMIC EMERGENCY MEDICINE 2011; 18:451–457 © 2011 by the Society for Academic Emergency Medicine

Delirium is an underrecognized public health problem affecting 8% to 10% of older emergency department (ED) patients.[1–3] This form of organ dysfunction incurs a significant economic burden, costing the United States health care system up to an estimated $152 billion per year in direct and indirect charges.[4] A large proportion of these costs are likely driven by prolonged hospitalizations observed in delirious

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Received July 26, 2010; revision received October 4, 2010; accepted October 8, 2010.

Presented at the Society for Academic Emergency Medicine annual meeting, Phoenix, AZ, June 2010.

Dr. Han received support from the Vanderbilt Physicians Scientist Development grant. Dr. Ely was supported in part by the National Institutes of Health AG27472 and the Veteran Affairs MERIT grant.

Supervising Editor: Christopher B. Carpenter, MD.

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doi: 10.1111/j.1553-2712.2011.01065.x
ISSN 1069-6563
PII ISSN 1069-6563583

patients.[5–8] However, most studies of delirium patients have been conducted in the inpatient setting, and their findings may have limited validity to the ED. Enrollment in these previous studies typically occurred within 24 to 48 hours after admission, and patients who were delirious in the hospital setting may not have been delirious in the ED. Conversely, because delirium can resolve within 24 hours in up to 51% of patients,[9] patients classified as nondelirious in the hospital may have been delirious in the ED. Currently, there are limited data on the consequences of delirium in the ED, especially in regard to its association with hospital length of stay (LOS). As result, we sought to determine if delirium in the ED is associated with prolonged hospital LOS in older patients.

METHODS

Study Design

This was a prospective cohort study. This analysis was designed prior to data collection and is part of a series of analyses designed to elucidate ED delirium's effect on patient outcomes. The local institutional review board approved this study with a requirement for obtaining verbal consent.

Study Setting and Population

Our setting was a tertiary care, university-affiliated ED with an annual census of approximately 55,000 visits, 10% of which are patients 65 years and older. Portions of this cohort have been used for prior publications,[1,10,11] but the outcomes used in this analysis have not been previously published.

The study was conducted from May 2007 to August 2008, and patients were enrolled from 8 AM to 10 PM. Patients were included if they were 65 years and older and were present in the ED for less than 12 hours at the time of enrollment. The rationale for the 12-hour limit was to maximize the number of patients that could be enrolled, while minimizing the patient's exposure to multiple delirium precipitants, such as the addition of three or more medications (including psychoactive medications), immobilization, bladder catheter placement, or any iatrogenic event.[12] This arbitrary time limit was also based on research assistant (RA) availability, our ED's typical waiting room times, duration of an older-patient evaluation, and emergency physician (EP) shift length. Patients were excluded if they were previously enrolled, were non–English-speaking, refused consent, were without a surrogate and not capable of providing consent, were unable to follow simple commands prior to their acute illness, were comatose, or did not have a delirium assessment performed by the research staff. Rationale for these enrollment criteria have been previously described in detail.[1,10,11] In summary, patients who were unable to follow simple commands were considered to have severe dementia and were excluded because no valid delirium assessment for nonpsychiatrists or non-geriatricians exists for this particular patient population. This was determined by interviewing a surrogate, if available, or the patient's nurse if from a nursing home. The RA would ask questions such as ''If I asked the patient to show me two fingers, would he/she be able to follow this command?'' If no surrogates were available, then the medical record was reviewed; if patients were able to provide a medical history in previous ED or clinic visits, then we assumed that they could follow simple commands at baseline. Because a patient must be arousable to verbal stimuli to be assessable for delirium, comatose patients were excluded.[13] For this analysis, both admitted and discharged patients were included; the rationale is provided in the subsequent paragraphs.

Study Protocol

Trained RAs (paramedics with over 20 years of clinical experience and medical students) prospectively measured delirium, dementia, and functional status in the ED. Prior to study onset, all RAs studied the training manuals, received didactic lectures, watched live patient demonstrations, and practiced administering the assessments using simulated patient scenarios over a 1-week period. To determine their competency, the principal investigator (JHH) observed the RAs perform these assessments with actual ED patients. All RAs were blinded to the study hypothesis.

Delirium was determined by using the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) at the time of enrollment only. This delirium assessment was chosen because of its brevity (<2 minutes), ease of use, and excellent interrater reliability in nonphysicians.[14,15] The CAM-ICU uses the same construct as the Confusion Assessment Method (CAM)[16] and consists of four features: 1) altered mental status or fluctuating course, 2) inattention, 3) disorganized thinking, and 4) altered level of consciousness. If features 1 and 2 are both present and either feature 3 or 4 is present, then the patient meets criteria for delirium. The CAM-ICU has excellent sensitivity (93% to 100%), specificity (89% to 100%) and interrater reliability between physicians and nurses (κ = 0.84 to 0.96).[14,15] A patient was classified as having dementia if one of the three was present: 1) documentation of dementia in the electronic medical record prior to the index ED visit, 2) a Mini-Mental State Examination (MMSE) less than 24,[17] or 3) a short form Informant Questionnaire on Cognitive Decline in the Elderly score greater than 3.38.[18] Functional status was determined by the Katz Activities of Daily Living (Katz ADL), which are based on the patient's level of independence in feeding, dressing, bathing, toileting, transferring, and continence.[19] Patients with a Katz ADL score of 4 or less were considered to be functionally dependent. All emergency and hospital physicians were blinded to all delirium, dementia, and functional assessments performed by the RAs.

Medical record review was performed after patient enrollment and the reviewer was blinded to the patient's delirium status. Charlson Comorbidity Index was calculated to measure comorbid burden.[20] The Acute Physiology and Chronic Health Evaluation II (APACHE II) score was also calculated to quantify severity of illness.[21] However, serum potassium and Glasgow Coma Scale scores were not used in the APACHE II calculation because they were not recorded for this study. Last, whether or not a patient underwent a surgical procedure was recorded as a dichotomous

variable. Only operative procedures requiring general anesthesia were considered to be positive responses. All data from the medical record were entered into a Microsoft Access 2003 database (Microsoft Corp., Redmond, WA). Validation rules were used, whenever possible, to minimize errors in data entry. Additionally, all study records were re-reviewed by the principal investigator and double checked for accuracy several months after initial data entry.

Length of stay was calculated by subtracting the date of ED visit from the date of hospital or ED discharge. We considered the patient's ED and hospital course to exist as a continuum. Hence, patients who were discharged from the ED were included in our analysis. Because the vast majority of older patients discharged from the ED are typically there for less than 24 hours, they were all considered to have a hospital LOS duration of 0 days. This decision was made a priori because this ED performs a significant number of evaluations that are typically performed only for inpatients at other hospitals. For example, this ED has easy access to a wide array of radiologic studies such as magnetic resonance imaging and stress nuclear testing. Inclusion of such patients would maximize the generalizability of our findings to other settings.

Data Analysis

Patients' baseline characteristics were summarized using proportions for categorical variables and medians and interquartile ranges (IQR) for continuous variables. For simple comparisons between delirious and nondelirious patients, chi-square analyses or Fisher's exact test were performed for categorical data, and Wilcoxon rank sum tests were performed for continuous data. The cumulative probability of remaining in the hospital was also estimated using the Kaplan-Meier product limit method for delirious and nondelirious patients. Comparisons between the two survival curves were made using the log-rank test.

Cox proportional hazards regression was performed to determine if delirium in the ED was independently associated with time to hospital discharge after controlling for age, Charlson Comorbidity Index, severity of illness (modified APACHE II), dementia, functional dependence (Katz ADL ≤ 4), nursing home residence, and surgical procedure. Although the APACHE II uses age in its calculation, we decided to adjust for it separately to minimize residual confounding. To reduce the likelihood of colinearity, we created the ''modified APACHE II,'' which removed age from the APACHE II calculation. Patients who died during hospitalization were censored at the time of death. The final model was internally validated using bootstrapping and helped determine the degree in which the model was overfitted.[22] Functional forms of the covariates were checked by plotting Martingale residuals as a function of each covariate.[23] Graphical examination of these plots showed good linear fit for all covariates; therefore, they were included in the model as linear terms. Proportional hazard assumptions were checked using the Schoenfeld residuals method.[24] Variance inflation factors were used to determine colinearity. Hazard ratios (HRs) and their 95% confidence intervals (95% CIs) are reported. Because time to discharge was the dependent variable, an HR < 1 indicated that ED patients with delirium were less likely to be discharged from the hospital.

To determine how the inclusion of older ED patients discharged from the ED affected our findings, we performed a sensitivity analysis that only included ED patients admitted to the hospital. For this analysis, we estimated the cumulative probability of remaining in the hospital using the Kaplan-Meier product limit method for delirious and nondelirious patients. In addition, we used the Cox proportional hazards regression model with the covariates listed in the previous paragraph. All statistical analyses were performed using open source R statistical software, version 2.9.2 (http://www.r-project.org/). Two-sided p-values less than 0.05 were considered statistically significant.

RESULTS

Of the 950 older ED patients screened, 163 refused consent, 68 were previously enrolled, 42 were without a surrogate and were not capable of providing consent, 12 were unable to follow simple commands at baseline, 16 were non–English-speaking, two were comatose, 17 did not have a CAM-ICU completed, and two withdrew from the study. As a result, 628 patients met enrollment criteria. Four patients (<1% of the entire cohort) died in the hospital and were censored in the subsequent survival analysis. Of those who died in the hospital, two patients had delirium in the ED.

One hundred eight (17.2%) patients met criteria for delirium and 351 (55.9%) were admitted. Of the 108 patients with delirium, 29 (26.9%) were discharged home. Patient demographics and characteristics stratified by delirium status can be seen in Table 1. Patients with delirium were more likely to be older and be admitted to the hospital. They were also more likely to have dementia, functional impairment, higher comorbidity burden, and higher severity of illness. With regard to EP diagnosis categorized by organ system, patients who were delirious in the ED were more likely to have neurologic diagnoses, but were less likely to have cardiovascular and gastrointestinal diagnoses. No differences in gender, race, and surgical status were observed.

Median, with IQR hospital LOS was 2 days (IQR = 0–5.5 days) for delirious ED patients and 1 day (IQR = 0–3 days) for nondelirious ED patients ($p < 0.001$). Kaplan-Meier curves were constructed for delirious and nondelirious ED patients (Figure 1). Those with delirium were significantly more likely to remain in the hospital compared with those without delirium (log rank $p < 0.001$). Cox proportional hazard regression (Table 2) shows that the HR of delirium in the ED was 0.71 (95% CI = 0.57 to 0.89) after adjusting for age, comorbidity burden, severity of illness, dementia, functional dependence, nursing home residence, and surgical procedure. There was no evidence of substantial overfitting. The Schoenfeld residual test indicated that the proportional hazard assumption was met. The variance inflation factor did not exceed 10 for all variables, indicating that there was no evidence of substantial colinearity.

Table 1
Patient Demographics and Characteristics for All Patients and Stratified by Delirium Status

Variable	All Patients (*n* = 628)	Delirium (*n* = 108)	No Delirium (*n* = 520)	p-value
Median age, yr	75 (69–81)	78 (72–84)	74 (69–80)	<0.001
Female	365 (58.1)	65 (60.2)	300 (57.7)	0.633
Nonwhite	111 (17.7)	23 (21.3)	88 (16.9)	0.278
Dementia	281 (44.7)	68 (63.0)	213 (41.0)	<0.001
Katz ADL ≤ 4	137 (21.8)	52 (48.2)	85 (16.4)	<0.001
Nursing home residence	58 (9.2)	20 (18.5)	38 (7.3)	<0.001
Median APACHE II (IQR)	8.0 (6.0–10.0)	8.5 (7.0–11.0)	2 (1–4)	0.006
Median Charlson Index (IQR)	2 (1–4)	3 (2–4)	2 (1–4)	<0.001
Triage ESI				
1	0	0 (0.0)	0 (0.0)	
2	382 (60.8)	69 (63.9)	313 (60.2)	0.853
3	129 (36.5)	36 (33.3)	193 (37.1)	
4	16 (2.5)	3 (2.8)	13 (2.5)	
5	1 (0.2)	0 (0.0	1 (0.2)	
Surgery performed in hospital	36 (5.6)	6 (5.6)	30 (5.8)	0.931
Admitted to the hospital	351 (55.9)	79 (73.1)	272 (52.3)	<0.001
EP Dx by organ system				
Cardiovascular	129 (20.5)	13 (12.0)	116 (22.3)	0.048
Gastrointestinal	92 (14.6)	11 (10.2)	81 (15.6)	
Genitourinary	46 (7.3)	11 (10.2)	35 (6.7)	
Neurologic	58 (9.4)	17 (15.7)	41 (7.9)	
Hematooncologic	18 (2.9)	3 (2.8)	15 (2.9)	
Pulmonary	63 (10.0)	14 (13.0)	49 (9.4)	
Trauma/musculoskeletal	125 (19.9)	21 (19.4)	104 (20.0)	
Other	97 (15.4)	18 (16.7)	79 (15.2)	

Continuous variables are represented as median (IQR), and categorical variables are represented as absolute number (%). Comparisons were made using the Wilcoxon rank sum test for continuous variables and chi-square or Fisher exact tests for categorical variables.
ADL = activities of daily living; APACHE II = Acute Physiology and Chronic Health Evaluation II; Dx = diagnosis; EP = emergency physician; ESI = emergency severity index; IQR = interquartile range.

Because our main analysis included patients who were directly discharged from the ED as well as those who were admitted to the hospital, we performed a sensitivity analysis to assess if delirium was associated with time to discharge only among patients admitted to the hospital. Among 351 patients who were admitted to the hospital, median LOS was 4 (IQR 2–7) days for delirious ED patients and 2.5 (IQR 1–5) days for nondelirious ED patients ($p < 0.001$). Kaplan-Meier curves were constructed for delirious and nondelirious ED patients (Figure 2) for admitted patients only. For the sensitivity analysis, patients with delirium were significantly more likely to remain in the hospital compared with those without delirium (log rank $p = 0.013$). The Cox proportional hazard regression was fit with the same list of covariates as in the main analysis (Table 2). The adjusted HR of delirium was 0.76 (95% CI = 0.58 to 0.99), indicating that among patients admitted to the hospital, patients diagnosed with delirium in ED were more likely to have prolonged hospital LOS compared with patients who were not delirious.

DISCUSSION

In our large cohort of older ED patients, we observed that delirium in the ED is an independent predictor of prolonged hospital LOS. This relationship persisted after adjusting for age, comorbidity burden, severity of illness, dementia, functional dependence, nursing home residence, and surgical status. Our study further confirms that delirium in the ED has an adverse effect on patient outcomes.

Previous reports investigating the relationship between delirium and hospital LOS have been conducted in patients enrolled in the hospital setting. The majority of these studies have observed an association between delirium and prolonged hospital LOS.[5–7] The mechanisms for this are most likely multifactorial. Patients with delirium are more likely to develop in-hospital complications such as urinary incontinence, decubitus ulcers, falls, and malnutrition compared with patients who never develop delirium.[4,25–27] However, the relationship between delirium and hospital LOS has not been universally observed. One study enrolled 359 hospitalized patients and reported that only patients who developed delirium in the hospital (incident delirium), but not those who presented to the hospital with delirium (prevalent delirium), were more likely to have prolonged hospital LOS.[8] Our study included patients who would have been classified as prevalent delirium in their inpatient study and appears to contradict their conclusions. Additional cohort studies are needed to help clarify this discrepancy.

Delirium has been shown to be associated with other adverse patient outcomes. Several studies have observed that delirium in the ED is associated with long-term mortality.[2,11,28] In hospitalized patients, delirium is also associated with accelerated functional and

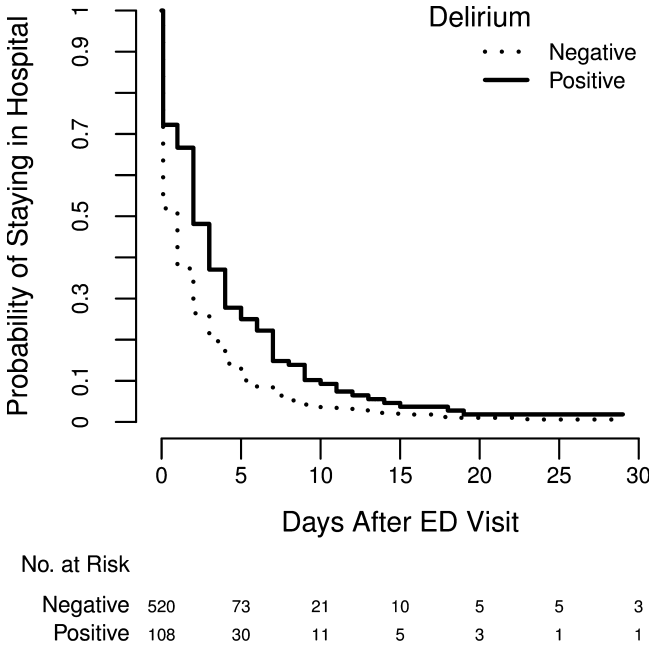

Figure 1. Kaplan-Meier curves showing time to hospital discharge in older ED patents with and without delirium ($p < 0.001$). The HR was 0.71 (95% CI = 0.57 to 0.89) after adjusting for age, Charlson Comorbidity Index, severity of illness, dementia, functional dependence, nursing home residence, and surgical procedure. This indicated that older ED patients with delirium were more likely to have prolonged hospitalizations compared with those without delirium. HR = hazard ratio.

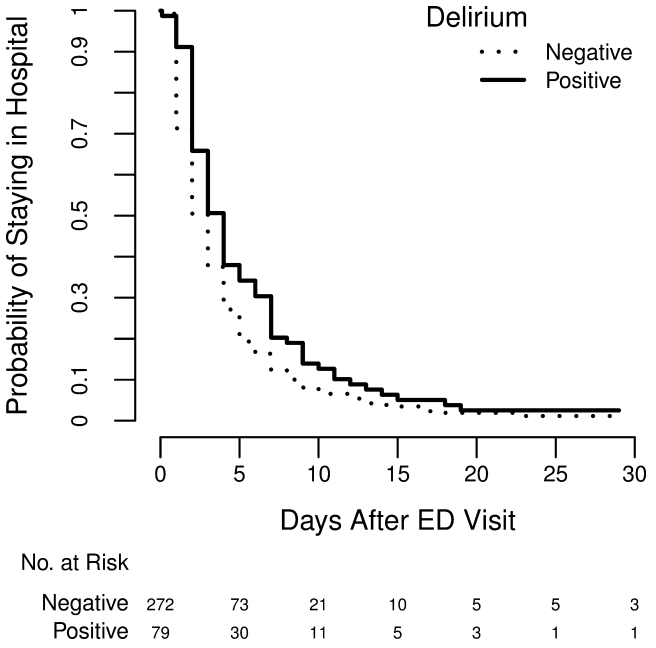

Figure 2. Kaplan-Meier curves showing time to hospital discharge in older ED patents who were admitted to the hospital only and stratified by delirium status ($p = 0.013$). In this sensitivity analysis, the HR was 0.76 (95% CI = 0.58 to 0.99) after adjusting for age, Charlson Comorbidity Index, severity of illness, dementia, functional dependence, nursing home residence, and surgical procedure. This indicated that admitted older ED patients with delirium were more likely to have prolonged hospitalizations compared with those without delirium. HR = hazard ratio.

Table 2
Cox Proportional Hazard Regression Models to Determine if Delirium Is Independently Associated With Hospital LOS

Variable	Main Analysis, HR (95% CI)	Sensitivity Analysis, HR (95% CI)
Delirium	0.71 (0.57–0.89)	0.76 (0.58–0.99)
Age (yr)	0.97 (0.87–1.09)	1.06 (0.91–1.23)
Charlson Index score	0.99 (0.90–1.10)	1.07 (0.94–1.22)
Dementia	0.87 (0.73–1.03)	0.88 (0.70–1.11)
Katz ADL ≤ 4	0.57 (0.38–0.85)	0.46 (0.28–0.78)
Modified APACHE II	0.76 (0.69–0.83)	0.80 (0.72–0.89)
Nursing home	0.56 (0.41–0.76)	0.64 (0.45–0.91)
Surgical procedure	0.25 (0.17–0.35)	0.32 (0.23–0.46)

The main analysis includes older ED patients who were both admitted and discharged from the hospital. The sensitivity analysis includes older ED patients who were admitted only. An HR of <1 indicates that patients were less likely to be discharged from the hospital.
ADL = activities of daily living; modified APACHE II = Acute Physiology and Chronic Health Evaluation II without the age component; HR = hazard ratio; LOS = length of stay.

cognitive decline,[29,30] which negatively affects quality of life. Despite being a marker for adverse outcomes, delirium is missed in up to 75% of older ED patients.[1] This occurs because it is not routinely screened for in the ED,[1] and this lack of screening has been characterized as a serious quality of care issue.[31] Additionally, there is evidence to suggest that in patients who are discharged from the ED, missing delirium can lead to higher mortality.[28] As a result, screening for delirium in the ED setting may be warranted.

The Society for Academic Emergency Medicine Geriatric Task Force recently recommended that delirium screening in the ED be one of the key quality indicators for emergency geriatric care.[32] However, barriers to routine delirium surveillance exist. Thus far, the CAM is the only delirium assessment validated for the ED setting.[33] However, it can take up to 10 minutes to perform, and may not feasible in a busy and challenging ED environment.[34] The CAM-ICU is a reasonable alternative as it takes less than 1 minute to perform in many cases.[35] However, this assessment still requires validation in the ED patient population. Fortunately, National Institutes of Health–sponsored investigations are currently ongoing to validate the CAM-ICU in the ED setting.

Uncertainties concerning the optimal management of delirium in the ED exist. Currently, the primary treatment for delirious ED patients is to diagnose and treat the underlying illness.[36] Over the past two decades, several multicomponent delirium interventions have been developed primarily for hospitalized patients,[37] but their efficacy is questionable, and this has limited their acceptance in the general medical community.[38] One significant limitation of these studies is that these interventions were started 24 to 48 hours after admission. It is possible that early detection and early intervention of delirium in the ED may improve the effectiveness of these interventions, similar to what has been observed with severe sepsis and ST-segment

elevation myocardial infarction care.[39,40] In addition, the mechanisms behind delirium's adverse effects remain unclear, especially in the ED setting. Perhaps elucidating these mechanisms will help direct the development of ED delirium interventions. Once developed, randomized controlled trials must be conducted to help determine if these ED interventions reduce hospital LOS and other adverse outcomes in a cost-effective manner.

LIMITATIONS

This study used a convenience sample of patients, and selection bias may have been introduced. Additionally, the proportion of older ED patients with delirium reported in our study is higher than what is reported in other literature.[1,3] Although this is likely driven by our high proportion of nursing home patients, it is also possible that delirious patients may have been inadvertently oversampled. However, the multivariable regression model should have helped minimize this bias, as it incorporated covariates that are known to affect LOS.

As with all studies conducted in a demanding ED environment, feasibility was an issue and the amount of prospective data collected was limited. Consequently, unmeasured confounders may have biased our multivariable model. Additionally, we also chose to use the CAM-ICU to assess for delirium because of its ease of use, brevity, and high reliability in nonphysicians. Although this instrument has not been formally validated in the ED setting, its validation studies include a wide variety of patients including those who were older and younger, sick and not sick, intubated and nonintubated, and with and without dementia.[14,15] Furthermore, delirium was measured at the time of enrollment. Because of the waxing and waning course of delirium, a small proportion of patients who were initially CAM-ICU negative may have become delirious later in the ED course. However, these misclassifications would have most likely biased our findings toward the null.

CONCLUSIONS

Delirium in older ED patients has negative consequences and is an independent predictor of prolonged hospitalizations. Future studies are needed to help determine the optimal management of delirium in the ED and if these interventions cost-effectively improve patient outcomes.

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