Delirium in Trauma Patients: Prevalence and Predictors

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Background Delirium is associated with increased mortality, morbidity, hospital costs, and postdischarge cognitive dysfunction. Most research focuses on nontrauma patients receiving mechanical ventilation in the intensive care unit.
Objectives To determine the prevalence and predictors of delirium in trauma patients residing in intensive and intermediate care units of an academic medical center.
Methods Trauma patients were screened for delirium by using the Confusion Assessment Method for the Intensive Care Unit. Exclusion criteria included documented brain injury, history of psychosis or cognitive impairment, not speaking English, and hearing or vision loss.
Results Of the 215 study patients, 24% were positive for delirium; 36% of patients in the intensive care unit and 11% of patients in the intermediate care unit. Delirium-positive patients were older (mean age, 53.4 years) than patients who were not (mean age, 44 years; $P = .004$). Although mechanical ventilation (odds ratio, 4.73, $P = .004$) was the strongest independent risk factor for delirium, 12% of delirium-positive patients were not receiving mechanical ventilation. Other predictors of delirium were use of antipsychotic medications, higher scores on the Acute Physiology and Chronic Health Evaluation III, and lower scores on the Richmond Agitation-Sedation Scale.
Conclusions Patients in both the intermediate and intensive care units, whether mechanical ventilation was used or not, were positive for delirium. Delirium prevention protocols may benefit trauma patients regardless of their inpatient location. (*Critical Care Nurse*. 2017;37[1]:40-48)

In the past 2 decades, delirium has been an increasing focus of research in critically ill patients receiving mechanical ventilation. Acute delirium, more recently referred to as acute brain dysfunction, has been reported in up to 60% to 80% of critically ill patients undergoing mechanical ventilation[1-3] and is often undiagnosed in hospitalized patients.[4,5]

CE 1.0 hour, CERP A

This article has been designated for CE contact hour(s). The evaluation tests your knowledge of the following objectives:
1. Describe the most significant predictors of acute delirium in this sample of trauma patients
2. Identify the prevalence of acute delirium in trauma patients who are not receiving mechanical ventilation
3. Discuss at least 2 implications for nursing practice based on the results of this study of trauma patients

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Delirium has a marked impact on patients' outcomes. It is associated with increased mortality,[2-4,6,7] length of stay,[2,8,9] and rate of postdischarge cognitive dysfunction and institutionalization.[10-13] Delirium leads to an additional 17.5 million inpatient days, with more than $5 billion in Medicare charges annually. Predictors of delirium include preexisting medical conditions, conditions associated with acute illness, as well as iatrogenic and environmental factors.[14,15] Preexisting or nonmodifiable risk factors for delirium at the time of hospital admission include advanced age (> 65 years), alcohol use, brain trauma, dementia, hypertension, smoking, depression, chronic illnesses, and male sex.[14,15] Illness-related factors include hypoxia, sepsis, metabolic and electrolyte disturbances, respiratory and cardiac failure, and immobility.[3,14,16] Iatrogenic factors include opioid, sedative, and antipsychotic medications; physical and chemical restraints; and nutritional deficiencies.[9,10,14-17] A recent systematic review suggested that age, dementia, coma, scores on the Acute Physiology and Chronic Health Evaluation (APACHE) II, previous delirium, emergency surgery and trauma, mechanical ventilation, and metabolic acidosis were well supported by evidence to contribute to development of delirium.[15]

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Incidence, risk factors, and predictors of acute delirium are widely reported in critically ill medical and surgical patients receiving mechanical ventilation, but less is known about acute delirium in trauma patients, particularly those who require mechanical ventilation. Studies of delirium in trauma patients have been retrospective in nature,[18,19] have included only patients undergoing mechanical ventilation,[5,17,20] or have had limited sample sizes.[5,17,20,21] The objective of this prospective, observational study was to determine the prevalence of delirium in trauma patients who reside in intermediate care units (IMCs) or in intensive care units (ICUs). Secondary aims were to explore and define characteristics and predictors of delirium in trauma patients.

Methods

The investigation was approved by the institutional review board with a waiver of informed consent as a noninterventional, observational point prevalence study.

This cross-sectional descriptive study was conducted at a large, urban academic trauma center and included patients from 3 trauma IMCs and ICUs. Data were collected during the day shift (between 7 AM and 7 PM) on 13 different days for several months. Prevalence, presence of delirium in patients on the data collection days, was used because the incidence of delirium could not be determined as delirium was not routinely assessed. The trauma center's daily patient census was used to identify potential study participants on each data collection day.

Eligible patients met the following inclusion criteria: 18 years or older, English speaking, no diagnosed traumatic brain injury, and a score of at least 8 on the Glasgow Coma Scale at the time of data collection. Exclusion criteria were nontrauma admissions, hospital readmissions, known history of psychosis or cognitive impairment, brain injury documented on computed tomography (CT) of the brain, significant hearing or vision loss, and a level of arousal less than -3 as defined by the Richmond Agitation-Sedation Scale (RASS). Because mild traumatic brain injury is difficult to diagnose and not readily detectable with brain CT,[22] these patients could not be excluded on the basis of a known brain injury. Other patients were excluded if they had previously been included in the study or were scheduled for surgery or hospital discharge on the screening and data collection days.

The data collected from medical records of eligible patients included mechanism of injury; demographics

Table 1 Prehospitalization characteristics of patients and relationships to acute delirium

Variable	No. (%) of patients			χ^2	*P*
	Total (N = 215)	No delirium (n = 164)	Delirium (n = 51)		
Male	164 (76.3)	124 (75.6)	40 (78.4)	0.2	.63
Female	51 (23.7)	40 (24.4)	11 (21.6)		
Mechanism of injury				4.5	.34
Vehicle	89 (41.4)	68 (41.5)	21 (41.2)		
Penetration	47 (21.9)	39 (23.8)	8 (15.7)		
Sports	6 (2.8)	6 (3.7)	0 (0)		
Crushing	9 (4.2)	7 (4.3)	2 (3.9)		
Falling	64 (29.8)	44 (26.8)	20 (39.2)		
Tobacco use	77 (35.8)	60 (36.6)	17 (33.3)	3.1	.38
Hypertension	61 (28.4)	44 (26.8)	17 (33.3)	1.6	.46
Vascular disease	19 (8.8)	13 (7.9)	6 (11.8)	1.3	.52
Depression	19 (8.8)	14 (8.5)	5 (9.8)	1.0	.62
Past illicit drug use	52 (24.2)	38 (23.2)	14 (27.5)	0.5	.76
Past alcohol use	49 (22.8)	33 (20.1)	16 (31.4)	3.1	.22

such as medical history, age, and sex; criteria for mild traumatic brain injury; past use of illicit drugs or alcohol; results of admission toxicology and blood alcohol screenings; use of medications known to affect delirium; illness severity as measured by APACHE III score; and presence of sepsis. Criteria for evaluating potential mild traumatic brain injury included at least 2 of the following: loss of consciousness for more than 30 minutes at the scene, amnesia at or near the time of the event, and score of 13 to 14 on the Glasgow Coma Scale on admission.[22] Medications administered to patients at the time of data collection that may influence results of the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU) and delirium were classified as sedatives (propofol, dexmedetomidine), antipsychotic agents (haloperidol, ziprasidone), benzodiazepines (lorazepam, diazepam, midazolam), and narcotics (fentanyl, hydromorphone, oxycodone). APACHE III score was used rather than APACHE II score to quantify illness severity because the APACHE III was developed from a more contemporary database[23,24] and assigns points for age ranges younger than the APACHE II score does. APACHE III has been validated in trauma patients.[25]

Eligible patients were assessed with the CAM-ICU to detect delirium. This well-validated tool evaluates for acute onset of changes or fluctuations in mental status, inattention, and either disorganized thinking or an altered level of consciousness.[26] Published directions for scoring the CAM-ICU are available.[27] Because the institution did not use a formal delirium assessment and prevention protocol at the time of the study, a team of 7 nurses was trained to use the CAM-ICU. Training, overseen by an expert clinical nurse specialist, was conducted via video and live demonstrations that used standardized scenarios with return demonstrations on patients. This team also collected all of the data from the medical records.

Statistical Analysis

Bivariate analysis with χ^2 test, *t* test, and correlation examined the association between the outcome variables of delirium and each factor. Variables showing a significant ($P < .20$) bivariate relationship to delirium were included in the final logistic regression to predict delirium. Logistic regression with a sample size of 215 observations achieved 84% power at a .05 significance level and medium effect size ($r = 0.3$).

Results

Of the 800 patients screened, 215 met eligibility requirements for inclusion. Many patients were excluded because of a large number of nontrauma admissions, readmissions, and patients with radiographically documented traumatic brain injuries during the data collection period. Overall delirium prevalence in this sample of trauma patients in both the ICUs and IMCs was 23.7% (n = 51). Patients' characteristics were classified into categories related to prehospitalization variables (Table 1),

Table 2 Admission variables and relationships to acute delirium

Variable	No. (%) of patients				
	Total (N = 215)	No delirium (n = 164)	Delirium (n = 51)	χ^2	*P*
Blood alcohol level > 0.08 mg/dL	55 (25.6)	41 (25.0)	14 (27.5)	0.4	.83
Toxicology screening positive	64 (29.8)	49 (29.9)	15 (29.4)	1.8	.41
Mild brain injury	37 (17.2)	27 (16.5)	10 (19.6)	4.8	.09

Table 3 Inpatient variables on the day of delirium assessment

Variables	Total (N = 215)	No delirium (n = 164)	Delirium (n = 51)	Statistic	*P*
APACHE III score, mean (SD)	29.3 (14.9)	26.4 (13.3)	38.9 (15.7)	$t = 5.75$	< .001
RASS score, mean (SD)	-0.39 (0.95)	-0.13 (0.56)	-1.22 (1.40)	$t = -5.58$	< .001
Location, No. (%) of patients				$\chi^2 = 18.7$	< .001
ICU	113 (52.6)	72/113 (63.7)	41/113 (36.3)		
IMC	102 (47.4)	91/102 (89.2)	11/102 (10.8)		
Mechanical ventilation, No. (%) of patients	48 (22.3)	22 (13.4)	26 (51.0)	$\chi^2 = 33.4$	< .001
Sepsis/infection, No. (%) of patients	31 (14.4)	21 (12.8)	10 (19.6)	$\chi^2 = 1.3$	.26
Benzodiazepines, No. (%) of patients	66 (30.7)	48 (29.3)	18 (35.3)	$\chi^2 = 0.6$	.43
Antipsychotics, No. (%) of patients	32 (14.9)	17 (10.4)	15 (29.4)	$\chi^2 = 11.0$	.001
Narcotics, No. (%) of patients	197 (91.6)	150 (91.5)	47 (92.2)	$\chi^2 = 0.4$	.54
Sedatives, No. (%) of patients	17 (7.9)	6 (3.7)	12 (21.6)	$\chi^2 = 19.9$	< .001

Abbreviations: APACHE III, Acute Physiology and Chronic Health Evaluation III; ICU, intensive care unit; IMC, intermediate care unit; RASS, Richmond Agitation-Sedation Scale.

admission variables (Table 2), and inpatient variables from the day of data collection (Table 3).

Prehospitalization variables included age, mechanism of injury, preexisting comorbid conditions, and history of tobacco, illicit drug, and alcohol use. The mean sample age was 46.3 years (SD, 14.9 years; range, 18-95 years). Significant differences were found in age between those who screened positive for delirium (mean, 53.4 years; SD, 20.0 years) and those who did not (mean, 44.1 years; SD, 19.6 years; $t = 2.95$, $P = .004$). In patients aged 65 years and older, 35% had delirium compared with 21% of patients less than 65 years old, but the difference was not significant ($\chi^2 = 3.4$, $P = .06$). No other significant relationships were found between prehospitalization variables and delirium (Table 1).

Admission variables included routinely collected blood alcohol level, results of drug toxicology screening, and signs and symptoms of mild brain injury (Table 2). None of these variables demonstrated a relationship with a positive finding on the CAM-ICU.

Inpatient variables from the day of delirium assessment included illness severity, patient location, RASS score, sepsis or infection diagnosis, use of mechanical ventilation, and administration of medications known to be associated with acute delirium (Table 3). Of the 215 eligible patients, 113 were in the ICUs and 102 were in the IMCs. ICU patients had a higher prevalence of delirium than IMC patients, with 36% of ICU patients screening positive for delirium versus 11% of patients in the IMC ($\chi^2 = 18.7$, $P < .001$). Lower RASS score was related to delirium ($t = -5.58$, $P < .001$). Of those testing positive for delirium, 40 patients (78%) had a RASS score of -1, -2, or -3. Higher severity of illness was associated with delirium. Mean APACHE III score was 38.9 (SD, 15.7) in CAM-ICU–positive patients compared with 26.4 (SD, 13.3) in CAM-ICU–negative patients ($t = 5.75$, $P < .001$).

Patients who screened positive for delirium differed significantly from patients who did not in the use of mechanical ventilation and medications (Table 3). Delirium was present in 51% of those requiring mechanical

ventilation ($\chi^2 = 33.8$, $P < .001$). The patients screening positive for delirium had greater use of antipsychotic agents (29% vs 10.4%, $\chi^2 = 11.0$, $P = .001$) as well as the use of sedative medications on the day of screening (21.6% vs 3.7%, $\chi^2 = 19.9$, $P < .001$). The use of benzodiazepines and narcotics did not differ between patients who screened positive for delirium and patients who were negative for delirium on the day of data collection.

Six variables showed at least small correlations with delirium: age ($r = 0.17$, $P = .003$), sedative use ($r = 0.29$, $P < .001$), mechanical ventilation ($r = 0.38$, $P < .001$), antipsychotic medication administration ($r = 0.23$, $P = .001$), APACHE III score ($r = 0.29$, $P < .001$), and RASS score ($r = -0.492$, $P < .001$). The best model included these 6 variables, significantly predicting delirium ($P < .001$), explaining 51.9% of variance (Cox and Snell $R^2 = 0.34$; Nagelkerke $R^2 = 0.52$). Table 4 shows the results of logistic regression. Four factors predictive of delirium were mechanical ventilation, use of antipsychotic agents, higher APACHE III score, and lower RASS score.

Table 4 Multivariate analysis of delirium predictors in trauma patients

Variable	Adjusted odds ratio (95% CI)	*P*
Age	1.017 (0.993-1.042)	.17
Sedative	1.235 (0.296-5.163)	.77
Mechanical ventilation	4.726 (1.628-13.716)	.004
Psychotropic agent	3.850 (1.280-11.579)	.02
APACHE III score	1.057 (1.020-1.095)	.002
RASS score	0.311 (0.188-0.516)	<.001

Abbreviations: APACHE III, Acute Physiology and Chronic Health Evaluation III; RASS, Richmond Agitation-Sedation Scale.

Discussion

In our study, 24% of trauma patients screened with the CAM-ICU tested positive for delirium in both ICUs and IMCs, with delirium affecting more ICU patients (36%). We suspect that the overall lower prevalence of delirium in our study compared with previous studies may be due to several factors. One factor was the small numbers of patients with preexisting comorbid conditions such as hypertension, vascular disease, and pulmonary disease. These small numbers were most likely due to the younger mean age of this trauma population compared with other studies of critically ill patients. Although the mean age of this sample was younger than the mean age in other investigations, older age was significant for higher prevalence of delirium and was included in the predictive model.

Our findings provide support that delirium is more likely to develop in patients undergoing mechanical ventilation than in those who are not.

Similar to other studies of delirium in trauma patients,[17,20,28] the age of our trauma patients and those patients testing positive for delirium were younger than the ages reported in the general ICU population.[1-3,9] These findings are important because younger patients are not usually considered to be at high risk for delirium. This finding underscores the need for delirium-prevention strategies in hospitalized trauma patients, regardless of the patients' age. Detrimental effects of delirium such as increased risk of death, dementia, and cognitive dysfunction following discharge from the hospital[7,11,14,29,30] underscores the significance of delirium prevention across the age span.

Admission variables identified by others to be related to delirium development include positive results of a toxicology screening, elevated blood alcohol content (> 0.08 g/dL), and abnormal score on the Glasgow Coma Scale (≤ 14). Unlike studies based on the National Trauma Databank[19] and a trauma registry,[18] positive blood alcohol on admission and history of alcohol use were not associated with or predictive of delirium in this study of trauma patients and in a large systematic review.[15] In addition, other previously reported risk factors such as positive results of drug toxicology screening on admission[19,21] and abnormal score on the Glasgow Coma Scale[21] were not related to delirium in our sample.

Inpatient variables associated with delirium include mechanical ventilation and administration of sedatives and analgesics.[9,10,15,17] Our findings provide additional support that delirium is more likely to develop in patients undergoing mechanical ventilation than in those who are not, although the prevalence of delirium in our sample of trauma patients receiving mechanical ventilation was lower than reported in other studies. This lower prevalence may be due to the younger age of trauma patients and fewer comorbid conditions that would predispose individuals to respiratory dysfunction or failure.

However, a number of the study patients in the ICU in whom mechanical ventilation was not being used

tested positive for delirium on the day of screening. Thomason and colleagues[31] similarly reported that 48% of medical ICU patients who were not receiving mechanical ventilation experienced at least 1 episode of delirium.

An important finding of this investigation was that patients who tested positive for delirium were not limited to those residing in the ICU. Of the trauma IMC patients, 11% screened positive for delirium, and mechanical ventilation was not in use in any of those patients. This finding is noteworthy because most studies have focused more exclusively on critically ill patients who require mechanical ventilation. These results suggest that implementation of delirium assessment and prevention strategies may benefit trauma patients who are not receiving mechanical ventilation or are not in the ICU.

Interestingly, half of the patients receiving antipsychotic (ziprasidone, haloperidol) or sedative (dexmedetomidine, propofol) medications tested positive for delirium. At the time of this study, use of ziprasidone, dexmedetomidine, and haloperidol was the common practice in our trauma center for treating agitation or suspected delirium. The high percentage of patients receiving these medications also may have been related to deliberate attempts to avoid benzodiazepines and narcotics to facilitate more rapid liberation from mechanical ventilation, practices consistent with the current pain, agitation, and delirium guidelines.[32] Zall and colleagues[15] identified dexmedetomidine to be associated with reduced delirium occurrence. This same review and our analysis did not find the use of narcotics or benzodiazepines to be significantly associated with delirium on the day of data collection, although these agents have been reported to be risk factors for the development of delirium.[9,10,17] The use of these medications can result in a lower RASS score, which we found to be predictive of delirium. A RASS score of -1 to -3 was identified in 75% of the studied patients. Delirium is often underrecognized in this subset of patients.[1,5,11]

Higher illness severity has been associated with delirium.[10,14,15,18] Our findings were consistent with results of these other studies. In our sample, higher APACHE III scores were also predictive of delirium.

Mild brain injury is not easily detectable by brain CT and may go undiagnosed.[22,33] Thus, patients with normal findings on a brain CT scan but signs and symptoms of a possible mild brain injury were included in data collection to ascertain if delirium is related to mild brain injury. In trauma patients who are CAM-ICU positive, differentiating physiological dysfunction associated with mild traumatic brain injury and cognitive deficits related to delirium is important to guide appropriate interventions. Potentially because of the limited sample size, no significant relationship was detected between mild brain injury and delirium. Further exploration of this population of patients is warranted as previous studies have shown a positive relationship between these 2 variables.[13]

Limitations of this study merit further exploration. Delirium was not routinely assessed in the ICUs and IMCs of the trauma center at the time of this investigation, necessitating collection of data on point prevalence; thus the true incidence of delirium is not known, and we were inhibited from being able to monitor changes over time. We were unable to differentiate those patients who were receiving antipsychotic therapy for suspected delirium from patients receiving it for the prevention or management of agitation.

Although we explored a wide variety of variables, it is possible that other factors such as use of isolation for antibiotic-resistant infections, ICU stay before IMC admission, as well as the types and quantities of deliriogenic medications received before the data collection day could also contribute to the development of delirium.

Of the trauma intermediate care unit patients, 11% screened positive for delirium, and mechanical ventilation was not in use in any of those patients.

Finally, this study was not designed to evaluate long-term effects of delirium. Although we know from other studies that episodes of acute delirium are detrimental to long-term health outcomes, we were unable to draw conclusions specifically related to our younger trauma patients. This topic is a potential area for study in trauma patients. Other foci for future research include investigating the impact of a delirium prevention initiative in patients who are not receiving mechanical ventilation or who have mild traumatic brain injury.

Studies related to the prevention of delirium in the trauma population are limited. Education regarding delirium before implementing a screening program may be effective in preventing delirium.[32,34] Use of validated assessment tools for pain, agitation, and delirium in conjunction with delirium-prevention strategies is

supported by current guidelines to reduce ventilator days and hospital length of stay and to improve other outcomes for trauma patients.[28,32,35]

Nurses are in a pivotal position to implement standards for delirium assessment and best practices for prevention of delirium such as the ABCDE bundle described in the American Association of Critical-Care Nurses' delirium practice alert[36] and the Society for Critical Care Medicine's interdisciplinary guidelines for pain, agitation and delirium.[32] Other nonpharmacological strategies that are within the nursing scope of practice include interventions such as music or light therapy, use of earplugs, and sleep promotion.[37,38] Thus, through independent interventions, nurses are able to directly influence the outcomes of trauma patients and others who are at risk for delirium developing, by reducing the occurrence of acute delirium and therefore its untoward effects on length of stay, mortality, long-term cognitive function, and cost of care.[39]

Conclusions

In this study, delirium was detected in nearly 24% of hospitalized trauma patients. Use of mechanical ventilation and psychotropic medications, higher APACHE III score, and lower RASS score were independent predictors of delirium. Although the presence of delirium in the current investigation was lower than reported in other studies of critically ill patients, our subset of trauma patients was younger, had fewer comorbid conditions, and included patients not receiving mechanical ventilation and IMC patients. Importantly, delirium was present in both the IMC patients and the patients not receiving mechanical ventilation. These findings suggest that delirium assessment and incorporation of delirium-prevention strategies into the routine management of all hospitalized trauma patients may be beneficial. Considering the unfavorable effects that delirium has on patients and their postdischarge outcomes, nurses' attention to prevention strategies is crucial. CCN

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None reported.

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See also

To learn more about caring for patients with delirium, read "Effect of ABCDE Bundle Implementation on Prevalence of Delirium in Intensive Care Unit Patients" by Bounds et al in the *American Journal of Critical Care*, November 2016;25:535-544. Available at **www.ajcconline.org**.

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Delirium in Trauma Patients: Prevalence and Predictors

Delirium is associated with increased mortality, morbidity, hospital costs, and postdischarge cognitive dysfunction. Most research focuses on nontrauma patients receiving mechanical ventilation in the intensive care unit.

- The objective of this study was to determine the prevalence of delirium in trauma patients who reside in intermediate care units or in intensive care units. Secondary aims were to explore and define characteristics and predictors of delirium in trauma patients.
- This cross-sectional descriptive study was conducted at a large, urban academic trauma center and included patients from 3 trauma intermediate care units and intensive care units.
- Eligible patients met the following inclusion criteria: 18 years or older, English speaking, no diagnosed traumatic brain injury, and a score of at least 8 on the Glasgow Coma Scale at the time of data collection.
- Of the 800 patients screened, 215 met eligibility requirements for inclusion.
- In our study, 24% of trauma patients screened with the Confusion Assessment Method for the Intensive Care Unit tested positive for delirium in both intensive care unit and intermediate care units, with delirium affecting more intensive care unit patients (36%).
- In this study, delirium-positive patients were older (mean age, 53.4 years) than patients who were not (mean age, 44 years).
- Although mechanical ventilation was the strongest independent risk factor for delirium, 12% of delirium-positive patients were not receiving mechanical ventilation.
- Other predictors of delirium were use of antipsychotic medications, higher scores on the Acute Physiology and Chronic Health Evaluation III, and lower scores on the Richmond Agitation-Sedation Scale.
- Nurses are in a pivotal position to implement standards for delirium assessment and best practices for prevention of delirium such as the ABCDE bundle described in the American Association of Critical-Care Nurses' delirium practice alert and the Society for Critical Care Medicine's interdisciplinary guidelines for pain, agitation, and delirium.
- Other nonpharmacological strategies that are within the nursing scope of practice include interventions such as music or light therapy, use of earplugs, and sleep promotion.
- Through independent interventions, nurses are able to directly influence the outcomes of trauma patients and others who are at risk for delirium developing, by reducing the occurrence of acute delirium and therefore its untoward effects on length of stay, mortality, long-term cognitive function, and cost of care. CCN

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