



Effectiveness of a Multifaceted Delirium Screening, Prevention, and Treatment Initiative on the Rate of Delirium Falls in the Acute Care Setting

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Delirium is a potentially modifiable fall risk factor, but few studies address the effects of delirium programs on falls. Beginning in 2011, we implemented a nursing-driven hospitalwide delirium program targeting improvements in risk identification, prevention, detection, and treatment. Over the course of the program, delirium falls decreased from 0.91 to 0.50 per patient day ($P = .0002$). A decrease in overall falls was also noted ($P = .0007$). **Key words:** *delirium, falls, falls prevention, hospital falls, Lean methodology*

FALL RISK identification and fall prevention efforts have been pursued for more than 25 years.¹ However, as recently as the year 2000 falls resulted in 1.8 million emergency department visits, 433 000 hospital admissions, and 15 800 deaths among people older than 65 years in the United States.² In 2008, the Centers for Medicare & Medicaid Services identified falls as a “never event”

in hospitalized patients.³ In a recent study, 96% of patients who fell in hospitals had evidence of delirium on chart review.⁴ Patients experiencing delirium while hospitalized are 6 times more likely to fall after discharge from the hospital.⁵ In addition, the cost of treating delirium (a condition where up to 40% of cases are preventable) in the United States is estimated to be \$164 billion.⁶ Recent literature strongly recommends addressing patient-specific modifiable risk factors such as delirium in fall prevention programs.⁷

Despite the association of delirium and falls in hospital, the literature on the effectiveness of delirium prevention and treatment on fall prevention remains limited.^{7–9} Of the 4 published delirium prevention studies included in a recent meta-analysis, only 1 showed statistically significant improvement in falls, and this study involved admitting intervention patients to a specialized geriatrics ward, an approach that may not be realistic for most hospitals.¹⁰ Others relied on volunteers to support the intervention, an approach that turned out not to be sustainable.^{9,11}

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Furthermore, published studies have focused on overall fall rates, without corresponding evidence that any fall reductions that are occurring are related to delirium and without controlling for any confounding temporal trends or interventions.

A 2011 review of all falls in our organization's hospital setting revealed that 51% were associated with delirium. This finding in conjunction with evidence suggesting that hospital-based delirium is largely preventable triggered the 2012 initiation of a multiyear multidisciplinary organizationwide delirium initiative.⁷ The goal of the initiative was a reduction in delirium-associated falls through prevention, early recognition, and treatment of delirium in the hospital. This study reports the effectiveness of this hospitalwide intervention in decreasing delirium-associated falls.

METHODS

The delirium program was designed, tested, and implemented at a multidisciplinary health care network in the Pacific Northwest with approximately 470 physicians and 17 000 admissions to the single-network hospital annually. The program focus targeted the 336-bed tertiary care hospital setting including critical care, intermediate/step-down, telemetry, medical-surgical, observation, and inpatient rehabilitation nursing units. The organization uses Lean methodology as its structure for daily management and quality improvement (QI).¹²

Delirium intervention

Program framework

As guided by the chief nursing officer and medical director of the hospital, a multidisciplinary team approached the work from 2 major angles: delirium treatment (identifying delirium early and implementing interventions to mitigate its effects) and delirium prevention (identifying at-risk patients and implementing preventive interventions). The team membership consisted of executive nursing and provider leadership, nurses,

hospital and clinic providers, a psychiatrist, clinical educators, clinical nurse leaders, QI staff, and a clinical project manager. The team used Lean methodology including Plan-Do-Study-Act cycles throughout program design, implementation, and evaluation to support mistake-proofing processes and facilitate inspection, standard work, and visual controls, with the goal of enhancing system reliability over time.¹²

Delirium identification and treatment

Implementation of delirium identification and treatment throughout the hospital occurred through an organizational initiative beginning with the electronic health record (EHR)-based Confusion Assessment Method (CAM) screening tool in 2011 (Supplemental Digital Content, Table, on QI timeline available at: <http://links.lww.com/JNCQ/A375>). The literature reports that delirium detection in the absence of a validated tool is ineffective in the hospital setting.¹³ Therefore, staff education and the use of a validated delirium screening tool are recommended.¹³ The multidisciplinary team elected the CAM, as the literature demonstrates its sensitivity (94%-100%), specificity (90%-95%), and ease of use and recommends its use as a bedside delirium detection tool.^{13,14} To facilitate detection in mechanically ventilated patients, the CAM-ICU tool as developed by a team at Vanderbilt (2001) was implemented in the critical care unit.¹⁵ The team started the project with delirium screening not only to allow for early identification but also to raise staff awareness of delirium in the hospital.

CAM accuracy was identified as an opportunity in 2013. Improvement work targeted linkage of nursing assessment terms to the CAM in a document called "The Language of Delirium." In 2014, the team implemented weekly multidisciplinary (primary nurse, nurse educator, and clinical nurse leader) rounds with nursing staff focused on delirium detection and interventions. The "The Language of Delirium" was a critical teaching tool during these rounds.

Delirium risk identification and prevention

As the work on delirium detection continued, the focus expanded in 2012 to delirium risk identification and prevention. The multidisciplinary workgroup designed, tested, and implemented a nursing-focused evidence-based prevention bundle. Specifically, evidence-based nonpharmacological interventions included efforts to minimize, treat, or prevent sensory deprivation or overload; impaired sleep-wake cycle; immobility; poor nutrition or dehydration; urinary retention; constipation; suboptimal pain management; deliriogenic medications; unnecessary lines or tethers; hypoxia; and alcohol withdrawal.⁷ Education for staff, patients, and families was also concurrently developed and implemented.

A delirium risk identification form to be completed for every hospitalized patient at the time of admission facilitated appropriate, timely initiation of the bundle.⁷ The EHR-based form included older than 65 years, preexisting cognitive impairment, history of delirium, and alcohol use (National Institute on Alcohol Abuse and Alcoholism single-screening question for alcohol use disorders).^{7,16} Answering “yes” to any of the risk identification questions automatically prompted the registered nurse to initiate delirium prevention and multicomponent interventions, as discussed earlier. For patients determined to be at risk, family members participated by filling out a paper cognitive baseline form that assisted clinical staff in assessing risk and detecting mental status changes.

Delirium treatment

In 2013, the team began targeting delirium treatment. Through the creation and implementation of standardized EHR-based order sets, patients with confirmed delirium received evaluation and treatment by the provider for specific causes as clinically indicated: medication review, infection workup, metabolic abnormality screening, substance withdrawal management, and anemia.⁷

Program measurement

Throughout the project, the team leveraged data to measure progress, guide further work, and evaluate outcomes. Delirium-associated falls root cause analysis began in 2013. The accountable nurse leader or clinical quality nurse reviewed every fall for delirium using “The Language of Delirium” tool.^{4,17} A hospital-based psychiatrist was available to facilitate consensus. After using root cause analysis to understand opportunities for each delirium fall, the nurse leader created and implemented an action plan. Leaders shared outcomes in weekly fall meetings. The group evaluated each action plan for potential spread to other nursing units. Beginning in 2014, quarterly CAM accuracy audits utilizing “The Language of Delirium” tool supported ongoing evaluation of delirium detection interventions.

Study of the intervention

To evaluate the effectiveness of the delirium program, we performed a retrospective interrupted time series cohort study using historical controls. All patients admitted to hospital nursing units from January 2011 to January 2017 were included. Patients in the ambulatory and emergency department setting were excluded, as were patients who fell before arriving on the inpatient hospital unit.

The primary outcomes were the number of delirium-associated falls and overall falls. All falls were captured from the patient safety incident reporting system, with the presence or absence of delirium at the time of fall confirmed by retrospective chart review completed by either a QI nurse or a hospital-based psychiatrist.¹⁸ Analysis of reliability of chart abstraction through double review of 20 randomly selected patient charts showed satisfactory interobserver agreement ($\kappa = 0.68$).

Secondary outcomes included compliance with delirium screening, measurement through identification of documentation of 2 CAM assessments per patient per day in the EHR. We also estimated CAM accuracy on a quarterly basis from Q4 2014 through Q1

2016 through review of randomly selected patient charts (20 per nursing unit per quarter). Quality improvement nurses used “The Language of Delirium” tool as the reference standard for determining CAM accuracy. We also evaluated the overall staffing levels and the use of nursing assistants (sitters) in one-on-one monitoring of patients with delirium, as potentially confounding the relationship between our intervention and the rate of falls. This investigation was performed as part of a QI project, and a waiver was granted from the institutional review board.

Data analysis

For analysis, we defined 3 periods: a preintervention period from January 2011 to January 2012, an intervention period encompassing February 2012 to June 2014, and a postintervention period from July 2014 to January 2017. The primary analysis was comparing preintervention with postintervention using the *t* test. In addition, to understand any underlying temporal trend independent of the intervention, and to evaluate the tempo-

ral relationship of the intervention to any observed differences, we analyzed the outcome data graphically using statistical process control charts, with interrupted time series regression. All analyses were performed using STATA v.12.0 (College Station, Texas).

RESULTS

Through the course of the project, the mean age of delirium fall patients was unchanged: 67.5 years in the preintervention period and 68.1 years postintervention ($P = .78$). Interestingly, the proportion of females who experienced a delirium fall decreased from 42% to 32% ($P = .006$) (Table).

Quality improvement audits of CAM completion demonstrated improved compliance over time. Completion of the CAM assessment at least twice per day for every hospitalized patient was 9.5% of patient days in the initial baseline audit in early 2011, increasing with initiation of the QI effort in 2012 and ending at 86% by 2015. Audits of CAM accuracy between 2012 and 2016 were between

Table. Falls and Delirium Falls

	Preintervention Period ^a Mean (SD)	Intervention Period ^b Mean (SD)	Postintervention Period ^c Mean (SD)	<i>P</i> Value (After-Before)
Falls^d				
Months, n	13	28	31	
Patients, n, d/mo	7095 (326)	7154 (380)	6596 (952)	.07 (NS)
All falls/ 1000 patient days	2.58 (0.53)	2.02 (0.62)	2.03 (0.42)	.0007
Delirium falls/ 1000 patient days	0.91 (0.39)	0.75 (0.40)	0.50 (0.27)	.0002
Delirium patients				
Delirium falls, n	84	150	105	
Age, y	67.5 (16.1)	70.0 (14.3)	68.1 (15.8)	.78
Female, %	42 (50)	55 (37)	32 (30)	.006

Abbreviations: NS, nonsignificant; SD, standard deviation.

^aJanuary 2011 to January 2012.

^bFebruary 2012 to June 2014.

^cJuly 2014 to January 2017.

^dMean of monthly totals.

85% and 98% (average 91%, 1297/1422) over 7 measurements.

Of the potential confounders, sitter hours were variable, and data were complicated as payroll system reports included sitters used for nondelirium indications such as suicidal ideation. However, the use of sitters actually decreased following the intervention. During the preintervention period, sitter hours averaged 4.8% of total care hours, decreasing to 4.0% during the intervention, and 2.3% in the postintervention period ($P < .001$). Finally, we identified a slight increase in overall hospital unit staffing, from 10.9 hours per day preintervention to 11.0 hours per day during the intervention and 11.5 hours per day postintervention ($P < .001$).

Before the intervention, the rate of delirium falls was 0.91 per thousand patient days. During implementation of the nursing-focused intervention, the rate decreased to 0.75 per thousand patient days before stabilizing at a postintervention rate of 0.50 per thousand patient days ($P = .0002$) (Supplemental Digital Content, Figure, available at: <http://links.lww.com/JNCQ/A376>). The rate of delirium falls with injury was too low for analysis. Overall hospital falls also decreased during the period from 2.58 to 2.03 per thousand patient days ($P = .0007$) (Table).

DISCUSSION

In this report, we demonstrate that our delirium prevention and treatment program was associated with a decrease in the rate of delirium-associated falls and a corresponding decrease in overall hospital falls. Although fall prevention has been a priority for many institutions and national organizations over the last decade, falls remain a substantial problem in hospitalized patients. Our results suggest that a focus on delirium as an underlying cause can enable institutions to achieve greater success in fall prevention.^{7,8}

Our organization had a fall program in place at the time of the intervention. This program's most recent iteration was fully implemented in late 2009 and included fall risk assessments

on admission and every 8 hours using the John Hopkins Fall Risk Assessment Tool.¹⁹ Universal fall precautions protected every patient regardless of the risk score. These included fall prevention education in the form of a video, brochure, and verbal teaching given by nursing staff. In addition, nursing staff facilitated a safe environment (adequate lighting, nonslip footwear, minimizing slip/trip hazards, keeping frequently used items and mobility devices within reach, and encouraging use of glasses, hearing aids, and other assistive devices). A fall prevention intervention checklist guided care for patients determined to be at risk. The checklist included visual cues (door signage, yellow socks, and yellow armbands), bed and chair exit alarms, supervised mobility and toileting, use of a gait belt for mobility, toileting schedules, and hourly rounding. The nursing teams discussed at-risk patients in daily huddles. Lastly, fall risk status and plan were shared at nursing shift handoff and transfer to facilitate continuity of care.¹³ The delirium intervention was in addition to these more general fall prevention strategies.

Hshieh and others⁷ in a meta-analysis found that, in 4 studies of delirium programs and falls, the overall fall rate decreased significantly (62%) in study groups. Several included studies demonstrated decreases in overall falls after implementation of the Hospital Elder Life Program multicomponent delirium prevention framework. One report by Bradley et al⁸ found that the overall falls rate (falls per 1000 patient days) decreased on a study unit from 5.15 to 2.49. Unfortunately, the investigators did not specifically address the rates of falls associated with delirium. In addition, the Hospital Elder Life Program was discontinued after the study, as it required the use of volunteers and other resources that were not sustainable.⁷ Our study results are unique in that the rate of delirium-associated falls decreased.²⁰ In addition, the delirium program continues to be sustained without the need for additional resources (volunteers, additional staff, and new nursing units) used in other studies. Our hospitalwide multiyear implementation facilitated Plan-Do-Study-Act

cycles and analysis in the inpatient environment, allowing the team to make and thoroughly evaluate adjustments on the basis of “real-world” observations and metrics. Our results support recommendations in the fall prevention literature that patient-specific modifiable risk factors such as delirium be identified and addressed as a part of the overall fall program.^{20,21}

This project was multidisciplinary and required change in practice from nursing, providers, pharmacists, leaders, and other members of the care team. Creation and redesign of care processes, documentation, and tools provided the foundation but were not the sole products. The team combatted the perception of delirium as an unavoidable consequence of hospitalization and illness through education.⁶ Active and continuous change management was critical to successful implementation. In particular, the team focused on empowerment of bedside nurses in delirium prevention, detection, and treatment.

The setting of the delirium program most likely had some effect on its success. As an organization that employs Lean methodology led by multidisciplinary teams, the framework for involving needed stakeholders (including direct care staff) already existed at the program’s inception.^{12,18} An existing organizational focus on rapid cycle process improvement, creation and adherence to standard work, and mistake proofing at a system level also supported the implementation of the multicomponent, multidisciplinary, hospitalwide program.¹² Lastly, clear and consistent support from executive nursing and medicine leaders provided guidance and direction and assisted with buy-in and removal of barriers.

Limitations

There are several limitations to our study of the delirium program. First, delirium is a clinical syndrome.⁷ Diagnosis is subjective and based on a constellation of factors.⁷ We relied on chart review to confirm the diagnosis of delirium in patients who fell. The chart review did show reasonable interob-

server agreement, but we acknowledge that this assessment is somewhat subjective. However, the consistent decrease in both delirium-associated falls and overall falls supports that our results are valid and not affected by misclassification of patients with delirium. Second, the program was hospitalwide using historical controls for comparison without randomization. The number of delirium-associated falls with injury was too low for analysis. We use statistical process control charts to assess temporal trend but acknowledge that we are unable to confirm causality. Also, we were unable to ascertain the effectiveness of each component of the intervention in isolation.

Third, fall reporting is dependent on direct care staff entering an alert into the patient safety system, creating potential for gaps in falls data. However, this system had been a mature standard at the project’s inception, so we would not expect any change in reporting.¹⁷ Fourth, hospital unit staffing (total hours per patient day) increased through the course of the intervention. The effect of this on our results is unknown. However, our staffing increase mirrors national trends.²² Importantly, the rate of nurse assistant “sitters” actually decreased during the study, negating this as a possible confounder. The fall literature, including a nationwide study of more than 300 000 falls, does not show a consistent, significant linkage between nurse staffing and falls.²³ In addition, there is no available literature on delirium-associated falls (our outcome of interest) and nurse staffing. Lastly, because of other work occurring simultaneously in our organization, we were unable to measure the program’s effects on length of stay or costs of hospitalization.

Nursing implications

Nurses were central to the success of the delirium program. As frontline clinicians, they performed real-time delirium assessments and were empowered to immediately implement nonpharmacological prevention and treatment interventions on the basis of the individual needs of the patient. Our results show

that implementation of a hospital-based delirium program should include nurses in this critical role. We also found that education related to delirium screening, prevention, and treatment and bedside tools such as “The Language of Delirium” are vital foundational elements necessary to nurse and program success.

CONCLUSIONS

A multicomponent nursing-focused delirium prevention and treatment program imple-

mented in the hospital setting decreased the rate of delirium-associated and total falls. The program was sustainable, with maintenance of the postintervention delirium fall rate at 0.50 per thousand patient days. The program was complex, and additional study is needed to better understand the impact of each component on delirium-associated falls. Overall, this work demonstrates the value of targeting patient-specific factors such as delirium to guide focused improvement work on hospital fall prevention.

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