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Clinical Predictors and Outcomes of Delirium in Elderly Patients Hospitalized with Acute Infections: A Prospective Observational Study in a Tertiary Care Medical College in Kerala

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ABSTRACT

Background: Delirium is an acute and fluctuating disturbance of attention and cognition frequently encountered among hospitalized elderly patients, with acute infections serving as important precipitating factors, particularly in those with underlying cognitive impairment, frailty and multiple comorbidities. This study aimed to determine the frequency of delirium and identify clinical predictors associated with its development among elderly patients hospitalized with acute infections.

Methods: A one-year prospective observational study was conducted among 150 patients aged ≥60 years admitted with acute infections at Amala Institute of Medical Sciences, Thrissur. Demographic, clinical, cognitive, functional and laboratory parameters were recorded. Delirium was assessed at admission and during hospitalization using the Confusion Assessment Method (CAM). Associated factors were analysed using univariable and multivariable logistic regression.

Results: Of 150 patients, 36 (24.0%) developed delirium, most commonly associated with respiratory tract infections. Delirium was significantly associated with older age, pre-existing cognitive impairment, functional dependence, hypoxemia, renal dysfunction and sodium abnormalities. These patients also had longer hospital stays (9 vs. 6 days; $p < 0.001$) and higher ICU admission rates (33.3% vs. 12.3%; $p = 0.003$). On multivariable analysis, independent predictors were pre-existing cognitive impairment (aOR 3.4), age ≥75 years (aOR 2.6), hypoxemia (aOR 2.5) and functional dependence (aOR 2.4).

Conclusion: Delirium affected one-fourth of elderly patients with acute infections. Advanced age, cognitive impairment, functional dependence and hypoxemia were independent predictors. Delirium was also associated with prolonged hospitalization and increased ICU admission, highlighting the importance of early screening and preventive interventions.

Key-words: Delirium; elderly; acute infection; Confusion Assessment Method; Cognitive impairment; Hypoxemia; Hospitalization

INTRODUCTION

Delirium is an acute neurocognitive syndrome characterized by disturbances in attention and awareness. It develops over a short period and typically follows a fluctuating course, with associated cognitive disturbances. It is a common clinical problem among older adults admitted to hospitals, particularly those suffering from acute medical illnesses and infections. Despite its clinical importance, delirium frequently remains under-recognized and may be mistaken for dementia, depression, or age-related cognitive decline. Early recognition is essential because delirium is associated with adverse hospital outcomes, including prolonged hospital stay, functional deterioration,

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increased healthcare requirements, and higher mortality [1–3].

The development of delirium is generally explained by the interaction between predisposing and precipitating factors. Advanced age, pre-existing cognitive impairment, dementia, frailty, functional dependence, sensory impairment, polypharmacy, and a previous history of delirium increase an individual's vulnerability. In older patients, even relatively minor acute physiological disturbances may trigger delirium because of reduced cognitive and physiological reserve. Acute infections, particularly severe infections and sepsis, are important precipitating factors in hospitalized elderly patients [4–7].

Infection-associated delirium may develop through several interrelated mechanisms. Systemic inflammation and the release of inflammatory mediators can affect central nervous system function and contribute to neuroinflammation. Hypoxemia, hypotension, cerebral hypoperfusion, dehydration, electrolyte disturbances, renal dysfunction, and other metabolic abnormalities may further impair cerebral function. Alterations in neurotransmitter activity, particularly reduced cholinergic activity and increased dopaminergic activity, have also been implicated in delirium pathogenesis. Sleep–wake cycle disturbances, pain, fever, and exposure to sedative or anticholinergic medications may additionally contribute to its development [4,5-14].

Clinically, delirium is classified into three subtypes: hyperactive, hypoactive, and mixed. Hyperactive delirium is characterized by agitation, restlessness, and increased motor activity, whereas hypoactive delirium presents with reduced activity, lethargy, and decreased responsiveness. Mixed delirium involves features of both forms. Hypoactive delirium is particularly challenging to recognize because its symptoms may be subtle and are often overlooked during routine clinical assessment. Therefore, systematic assessment is important for identifying different clinical presentations [1,3].

The Confusion Assessment Method (CAM) is a widely used tool for delirium identification and is based on acute onset or fluctuating course, inattention, disorganized thinking, and altered level of consciousness. Other validated instruments, including CAM-ICU and the 4AT, have also been used in different clinical settings. Regular assessment is important because delirium may develop at any stage during hospitalization and its clinical features can fluctuate over time [10–18].

Delirium is also associated with important short-term and long-term consequences. Affected patients may experience prolonged hospitalization, increased requirement for intensive care, functional decline, persistent cognitive impairment, and increased risk of death. Evidence suggests that early recognition, identification of precipitating factors, and multicomponent non-pharmacological preventive interventions can help reduce the occurrence and adverse consequences of delirium in hospitalized older adults [8,9,19,20].

Although delirium has been widely studied in general hospitalized and critically ill populations, infection-associated delirium in elderly medical patients remains an important clinical concern. Identifying the clinical and physiological factors associated with its development may help clinicians recognize high-risk patients and initiate timely assessment and management. Therefore, the present study aimed to determine the incidence of delirium, identify its clinical predictors, describe its clinical characteristics, and evaluate its association with hospital outcomes among elderly patients admitted with acute infections to a tertiary care hospital.

MATERIALS AND METHODS

Study Design and Setting- This prospective observational study was conducted in the Department of Internal Medicine, Amala Institute of Medical Sciences, Thrissur, Kerala, India, from May 2025 to June 2026.

Study Population and Sample Size- The study included 150 patients aged 60 years or older admitted with acute infections during the study period. Patients were recruited consecutively until the required sample size was achieved.

Inclusion Criteria- Patients aged ≥60 years admitted to the Department of Internal Medicine with a clinical diagnosis of acute infection supported by clinical, laboratory, microbiological and/or radiological evidence were included. Written informed consent was obtained from the patient or legally authorized representative.

Exclusion Criteria- Patients with delirium clearly attributable to non-infectious causes, acute primary neurological conditions, severe psychiatric illness

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preventing reliable cognitive assessment, persistent coma or deep sedation, terminal illness preventing assessment, or inadequate baseline clinical information were excluded. Patients with pre-existing dementia or mild cognitive impairment were retained in the study as these conditions are potential predisposing factors for delirium.

Operational Definitions- Acute infection was defined as a clinical syndrome compatible with an acute infectious process supported by clinical, laboratory, microbiological and/or radiological findings. Infection sources were classified as respiratory tract, urinary tract, bloodstream infection/sepsis, skin and soft tissue, intra-abdominal and other infections. Delirium was defined as an acute disturbance in attention and awareness with an associated change in cognition, developing over a short period and fluctuating during the day.

Assessment of Baseline Cognitive Status- Baseline cognitive status was assessed using patient history, family or caregiver interviews, previous medical records and a validated cognitive screening instrument where feasible. Pre-existing dementia or cognitive impairment was documented separately to distinguish chronic impairment from acute delirium.

Assessment of Delirium- All enrolled patients were assessed at admission and subsequently on a daily basis during hospitalization using the Confusion Assessment Method (CAM). Additional assessments were performed whenever a change in mental status was reported by the treating team, nursing staff or relatives. A positive CAM diagnosis required acute onset or fluctuating course and inattention, along with either disorganized thinking or altered level of consciousness. The date of first identification was recorded. Delirium was further classified as hyperactive, hypoactive or mixed according to the predominant psychomotor features.

Baseline Demographic and Clinical Variables- Demographic details, including age, sex, residence, living arrangement, educational status and pre-hospital functional status, were recorded. Clinical parameters at admission included temperature, heart rate, respiratory rate, blood pressure, oxygen saturation, level of consciousness, oxygen requirement, dehydration, pain, nutritional and functional status, sepsis and severity of infection.

Comorbidities- Relevant comorbidities, including hypertension, diabetes mellitus, chronic kidney disease, coronary artery disease, heart failure, chronic obstructive pulmonary disease, cerebrovascular disease, dementia or cognitive impairment, malignancy and chronic liver disease, were documented. The total number of significant comorbidities was also recorded.

Laboratory Investigations- Baseline investigations included complete blood count, hemoglobin, total leukocyte and platelet counts, serum sodium, potassium, calcium, magnesium, blood urea, serum creatinine, blood glucose, liver function tests, serum albumin, C-reactive protein and procalcitonin, where available. Arterial blood gas analysis and serum lactate were performed when clinically indicated. Relevant abnormalities were evaluated as potential precipitating factors for delirium.

Assessment of Infection Severity- Infection severity was assessed using clinically appropriate criteria. SOFA parameters were recorded in patients with suspected or confirmed sepsis, while CURB-65 was documented in patients with community-acquired pneumonia, where applicable. Other infection-specific severity measures were recorded according to clinical circumstances.

Medication Exposure- Medication history before admission and drugs administered during hospitalization were recorded, with particular attention to benzodiazepines, opioids, anticholinergic medications, sedative-hypnotics, corticosteroids and other centrally acting drugs. The number of pre-admission medications was documented to assess polypharmacy.

Potential Predictors Evaluated- Predisposing factors included advanced age, baseline cognitive impairment, dementia, frailty, functional dependence, sensory impairment, multiple comorbidities, polypharmacy and poor nutritional status. Precipitating factors included infection severity, sepsis, hypoxemia, hypotension, dehydration, electrolyte abnormalities, acute kidney injury, fever, pain, medication exposure and ICU admission.

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Study Outcomes- The primary outcome was the development of delirium during hospitalization. Secondary outcomes included delirium subtypes, independent clinical predictors, ICU admission, mechanical ventilation, length of hospital stay, in-hospital mortality, acute kidney injury and potentially modifiable precipitating factors.

Statistical Analysis- Data were analyzed using appropriate statistical software. Continuous variables were expressed as mean ± SD or median (IQR), and categorical variables as frequencies and percentages. Groups were compared using the Chi-square/Fisher's exact test or independent t-test/Mann–Whitney U test, as appropriate. Multivariable logistic regression identified independent predictors, with adjusted odds ratios and 95% confidence intervals. The model was limited to minimize overfitting.

Ethical Considerations- The study was conducted after obtaining approval from the Institutional Ethics Committee, Amala Institute of Medical Sciences, Thrissur. Written informed consent was obtained from participants or their legally authorized representatives. Confidentiality was maintained using unique study identification numbers, and all clinical decisions were made by the treating team as part of routine care.

RESULTS

Table 1 compares demographic characteristics, sources of infection, comorbidities, and baseline cognitive and functional status between patients with and without delirium. Patients who developed delirium were significantly older, with a higher proportion aged ≥75 years. Chronic kidney disease, heart failure, previous cerebrovascular disease, and pre-existing cognitive impairment were also significantly more frequent among patients with delirium. Functional dependence and frailty were significantly associated with delirium. Respiratory tract infection was the most common infection source in both groups. No significant differences were observed in sex, living arrangement, residence, hypertension, diabetes mellitus, coronary artery disease, COPD, malignancy, hearing impairment, visual impairment, or polypharmacy.

Table 1: Comparison of Characteristics between Patients with and Without Delirium

Variable	Delirium (n=36)	No delirium (n=114)	Total (N=150)	p-value
Demographic characteristics				
Age, mean ± SD (years)	75.8 ± 8.4	69.4 ± 8.9	-	<0.001
Age ≥75 years	23 (63.9%)	34 (29.8%)	57 (38.0%)	<0.001
Male sex	22 (61.1%)	70 (61.4%)	92 (61.3%)	0.98
Female sex	14 (38.9%)	44 (38.6%)	58 (38.7%)	0.98
Living alone	7 (19.4%)	12 (10.5%)	19 (12.7%)	0.15
Rural residence	24 (66.7%)	70 (61.4%)	94 (62.7%)	0.57
Source of infection				
Respiratory tract	15 (41.7%)	42 (36.8%)	57 (38.0%)	-
Urinary tract	8 (22.2%)	31 (27.2%)	39 (26.0%)	-
Bloodstream/sepsis	8 (22.2%)	15 (13.2%)	23 (15.3%)	-
Skin/soft tissue	2 (5.6%)	10 (8.8%)	12 (8.0%)	-
Intra-abdominal	2 (5.6%)	9 (7.9%)	11 (7.3%)	-
Other	1 (2.8%)	7 (6.1%)	8 (5.3%)	-
Comorbidities				
Hypertension	25 (69.4%)	72 (63.2%)	97 (64.7%)	0.51
Diabetes mellitus	20 (55.6%)	58 (50.9%)	78 (52.0%)	0.63
Chronic kidney disease	13 (36.1%)	19 (16.7%)	32 (21.3%)	0.015
Coronary artery disease	10 (27.8%)	22 (19.3%)	32 (21.3%)	0.29
Heart failure	8 (22.2%)	11 (9.6%)	19 (12.7%)	0.048

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COPD	9 (25.0%)	17 (14.9%)	26 (17.3%)	0.17
Previous cerebrovascular disease	8 (22.2%)	10 (8.8%)	18 (12.0%)	0.03
Malignancy	6 (16.7%)	12 (10.5%)	18 (12.0%)	0.35
Pre-existing cognitive impairment	14 (38.9%)	14 (12.3%)	28 (18.7%)	<0.001
Baseline cognitive and functional characteristics				
Functional dependence	19 (52.8%)	29 (25.4%)	48 (32.0%)	0.002
Frailty	17 (47.2%)	27 (23.7%)	44 (29.3%)	0.007
Hearing impairment	10 (27.8%)	17 (14.9%)	27 (18.0%)	0.08
Visual impairment	9 (25.0%)	19 (16.7%)	28 (18.7%)	0.28
Polypharmacy	18 (50.0%)	38 (33.3%)	56 (37.3%)	0.08

Note: *Data are presented as mean ± standard deviation or number (percentage), as appropriate. COPD: chronic obstructive pulmonary disease. Dashes indicate p values not provided in the original data.*

Table 2 compares clinical characteristics at admission and infection severity between patients with and without delirium. Hypoxemia, hypotension, dehydration, respiratory rate >24/min, sepsis, and oxygen requirement were significantly more frequent among patients who developed delirium. These patients also had significantly higher SOFA scores, a greater frequency of septic shock, and higher ICU admission rates. Mechanical ventilation was more frequent in the delirium group, although the difference was not statistically significant. Fever did not differ significantly between the groups.

Table 2: Comparison of Clinical Characteristics and Infection Severity between Patients with and Without Delirium

Variable	Delirium (n=36)	No delirium (n=114)	p-value
Clinical characteristics at admission			
Fever	27 (75.0%)	79 (69.3%)	0.51
Hypoxemia	16 (44.4%)	24 (21.1%)	0.006
Hypotension	9 (25.0%)	12 (10.5%)	0.03
Dehydration	13 (36.1%)	20 (17.5%)	0.02
Respiratory rate >24/min	18 (50.0%)	35 (30.7%)	0.04
Sepsis	17 (47.2%)	28 (24.6%)	0.01
Oxygen requirement	19 (52.8%)	35 (30.7%)	0.02
Infection severity			
Septic shock	5 (13.9%)	5 (4.4%)	0.04
SOFA score, median (IQR)	5 (3–7)	3 (2–5)	0.006
ICU admission	12 (33.3%)	14 (12.3%)	0.003
Mechanical ventilation	6 (16.7%)	7 (6.1%)	0.07

Note: *Data are presented as number (percentage) or median (interquartile range), as appropriate. SOFA: Sequential Organ Failure Assessment; ICU: intensive care unit.*

Table 3 compares laboratory parameters between patients with and without delirium. Serum sodium abnormalities, higher serum creatinine levels, acute kidney injury, and elevated lactate were significantly more frequent in patients with delirium. Hemoglobin levels, total leukocyte count, serum potassium abnormalities, and elevated CRP did not differ significantly between the groups.

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Table 3: Comparison of Laboratory Parameters between Patients with and without Delirium

Laboratory parameter	Delirium (n=36)	No delirium (n=114)	p-value
Hemoglobin (g/dL), mean ± SD	10.8 ± 1.8	11.4 ± 1.7	0.07
TLC (cells/mm³), mean ± SD	13,200 ± 5,100	11,800 ± 4,600	0.11
Serum sodium abnormality	11 (30.6%)	15 (13.2%)	0.015
Serum potassium abnormality	7 (19.4%)	14 (12.3%)	0.29
Creatinine (mg/dL), median (IQR)	1.7 (1.1–2.6)	1.2 (0.9–1.7)	0.004
Acute kidney injury	13 (36.1%)	19 (16.7%)	0.015
Elevated CRP	30 (83.3%)	79 (69.3%)	0.10
Elevated lactate	9 (25.0%)	13 (11.4%)	0.04

Note: *Data are presented as mean ± standard deviation, median (interquartile range), or number (percentage), as appropriate. TLC: total leukocyte count; CRP: C-reactive protein; IQR: interquartile range.*

Table 4 presents the frequency, subtypes, and timing of delirium among the study participants. Delirium developed in 36 of 150 patients (24.0%). Mixed delirium was the most common subtype (44.4%), followed by hypoactive (33.3%) and hyperactive delirium (22.2%). Regarding onset, 77.8% of cases developed within the first three days of hospitalization, highlighting the importance of early and systematic delirium screening.

Table 4: Frequency, Subtypes, and Timing of Delirium

Variable	Number (n=36)	Percentage (%)
Overall delirium incidence (N=150)	36	24
Delirium subtype		
Hyperactive	8	22.2
Hypoactive	12	33.3
Mixed	16	44.4
Timing of delirium onset		
Within 24 hours	13	36.1
Day 2–3	15	41.7
Day 4–7	6	16.7
After day 7	2	5.6
Total delirium cases	36	100

Table 5 compares hospital outcomes between patients with and without delirium. Patients who developed delirium had a significantly longer hospital stay (9 vs. 6 days) and higher rates of ICU admission and in-hospital mortality. Acute kidney injury was also significantly more frequent among patients with delirium. Although mechanical ventilation was more common in the delirium group, the difference was not statistically significant.

Table 5: Comparison of hospital outcomes

Outcome	Delirium (n=36)	No delirium (n=114)	p-value
Length of stay, median days (IQR)	9 (7–13)	6 (4–8)	<0.001
ICU admission	12 (33.3%)	14 (12.3%)	0.003
Mechanical ventilation	6 (16.7%)	7 (6.1%)	0.07
In-hospital mortality	5 (13.9%)	5 (4.4%)	0.04
Acute kidney injury	13 (36.1%)	19 (16.7%)	0.015

Patients with delirium had significantly longer hospital stays and higher rates of ICU admission and in-hospital mortality.

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Table 6 presents the univariable and multivariable logistic regression analyses of potential predictors of delirium. In univariable analysis, older age, baseline cognitive impairment, functional dependence, frailty, hypoxemia, sepsis, acute kidney injury, sodium abnormality, and dehydration were significantly associated with delirium. After adjustment for potential confounding factors, baseline cognitive impairment, age ≥75 years, hypoxemia, and functional dependence remained independent predictors of delirium. Baseline cognitive impairment showed the strongest independent association (adjusted OR 3.40, 95% CI 1.35–8.57; p=0.009).

Table 6: Univariable and Multivariable Analysis of Predictors of Delirium

Predictor	Univariable OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age ≥75 years	4.15	1.88–9.15	<0.001	2.60	1.16–5.83	0.020
Baseline cognitive impairment	4.53	1.86–11.01	0.001	3.40	1.35–8.57	0.009
Functional dependence	3.27	1.45–7.37	0.004	2.40	1.04–5.54	0.040
Frailty	2.87	1.27–6.49	0.011	-	-	-
Hypoxemia	2.99	1.30–6.87	0.010	2.50	1.05–5.96	0.038
Sepsis	2.75	1.22–6.20	0.015	-	-	-
Acute kidney injury	2.83	1.21–6.60	0.016	-	-	-
Sodium abnormality	2.90	1.14–7.39	0.026	-	-	-
Dehydration	2.66	1.08–6.54	0.034	-	-	-

Note: *OR: odds ratio; Adjusted OR: adjusted odds ratio; CI: confidence interval. Dashes indicate variables not retained in the final multivariable model.*

DISCUSSION

The present prospective observational study evaluated the incidence, clinical predictors and hospital outcomes of delirium among 150 elderly patients aged ≥60 years hospitalized with acute infections. Delirium developed in 36 patients, accounting for 24% of the study population. This finding highlights delirium as an important complication among elderly patients admitted with acute infections. Previous clinical guidelines and reviews have emphasized the importance of early recognition, prevention and appropriate management of delirium in hospitalized older adults [21-23].

Advanced age was significantly associated with delirium. Patients with delirium had a higher mean age than those without delirium, and age ≥75 years was associated with increased odds of delirium. On multivariable analysis, age ≥75 years remained an independent predictor (aOR 2.60; 95% CI 1.16–5.83; p=0.020). Age-related reduction in physiological reserve and increased vulnerability to acute illness may contribute to this association. Previous studies have also identified advanced age and pre-existing vulnerability as important risk factors for delirium [24,25].

Baseline cognitive impairment showed the strongest independent association with delirium in the present study (aOR 3.40; 95% CI 1.35–8.57; p=0.009). Patients with pre-existing cognitive impairment may have reduced cerebral reserve and greater susceptibility to acute physiological disturbances. Functional dependence was also independently associated with delirium (aOR 2.40; 95% CI 1.04–5.54; p=0.040). These findings emphasize the importance of assessing baseline cognitive and functional status during hospital admission. Previous reviews have similarly highlighted cognitive impairment, frailty and functional vulnerability as important predisposing factors [26–28].

Acute physiological disturbances, including hypoxemia, sepsis, acute kidney injury, sodium abnormalities and dehydration, were more frequently observed among patients who developed delirium. Hypoxemia remained an independent predictor after multivariable adjustment (aOR 2.50; 95% CI 1.05–5.96; p=0.038). Infection-related systemic inflammation, altered stress responses, impaired cerebral oxygenation and metabolic disturbances may contribute to delirium development. Previous studies have discussed the role of systemic inflammation and maladaptive sickness responses in delirium pathophysiology [29,30].

Delirium assessment in acutely ill patients can be challenging, particularly when behavioural

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manifestations are subtle or fluctuate over time. Previous studies have evaluated delirium detection in acute hospital and emergency department settings and emphasized the need for systematic assessment using validated tools [31,32]. In the present study, mixed delirium was the most common subtype (44.4%), followed by hypoactive delirium (33.3%) and hyperactive delirium (22.2%). The relatively high proportion of hypoactive and mixed presentations emphasizes the importance of systematic screening rather than relying only on overt agitation.

Regarding the timing of onset, 28 of the 36 delirium cases (77.8%) developed within the first three days of hospitalization. This finding supports early and repeated screening during the initial days of admission. Delirium assessment tools and diagnostic approaches have been evaluated in different acute-care populations, including older medical and emergency department patients [33,34]. The clinical importance of early recognition is further supported by evidence linking delirium with subsequent cognitive impairment, particularly among critically ill patients [35].

Polypharmacy was more frequent among patients with delirium, although the association was not statistically significant. Medications with sedative or anticholinergic effects may contribute to altered cognition in vulnerable older adults. Careful medication review and identification of potentially precipitating factors therefore remain important components of delirium prevention and management. Previous systematic reviews have also identified patient-related and clinical risk factors associated with delirium in hospitalized older adults [36,37]. Recent evidence has further examined the global burden of delirium and its associated risk factors among hospitalized older patients [37]. These findings reinforce the importance of identifying predisposing factors and potentially reversible precipitating conditions during hospitalization.

CONCLUSIONS

Delirium is a frequent and clinically significant complication among elderly patients hospitalized with acute infections, with an incidence of 24% in the present study. Its development reflects the interaction between baseline vulnerability and acute physiological stress. Baseline cognitive impairment, age ≥75 years, hypoxemia and pre-hospital functional dependence emerged as independent predictors. Delirium was also associated with prolonged hospital stay, increased ICU admission and higher in-hospital mortality. The findings emphasize the importance of early cognitive and functional assessment, regular CAM-based screening and prompt identification and correction of reversible precipitating factors. Early recognition and systematic management may help reduce delirium-related complications and improve inpatient care in elderly patients.

CONTRIBUTION OF AUTHORS

Research concept- Thomas Joseph, Mohammed Ramees Raja

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