

## Delirium in Intensive Care Unit: Phenomenology, Subtypes, and Factor Structure of Symptoms

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### ABSTRACT

**Aim:** This study aimed to explore the phenomenology, motor subtypes, and factor structure of symptom profile of delirium in patients admitted to the intensive care unit (ICU). **Methods:** Consecutive patients aged  $\geq 16$  years admitted in an ICU were screened daily for delirium using confusion assessment method-ICU. Patients diagnosed to have delirium as per Diagnostic and Statistical Manual fourth revision, text revision (DSM-IVTR) criteria were assessed with Delirium Rating Scale-Revised 98 (DRS-R 98) and Memorial Delirium Assessment Scale (MDAS). Motor subtypes of delirium were assessed with amended Delirium Motor Symptom Scale. **Results:** Sixty-six patients were evaluated for delirium, of which 45 (68%) patients developed delirium at point of their ICU stay. All patients had sleep-wake cycle disturbances, followed by motor symptoms (retardation - 80%; agitation - 73.3%). As per MDAS assessment, all the subjects had disturbances in the consciousness and sleep-wake cycle disturbances, and a substantial majority also had attention difficulties (93.3%) and motor symptoms (93.3%). Hypoactive subtype (47%) was the most common motoric subtype of delirium. Factor analysis revealed three-factor model for DRS-R 98, MDAS, and combining items of the two. **Conclusion:** Phenomenology of delirium in ICU setting is similar to that of the non-ICU settings. The factor analysis consistently demonstrated a three factor solution, with a robust attention-arousal factor, and overlapping cognitive (core vs. non-core) motor factors.

**Key words:** Delirium, factor analysis, intensive care unit, phenomenology, subtypes

### INTRODUCTION


Advancements in critical care has ensured that delirium which was under-appreciated for a long time to come up to the forefront because of its wide prevalence (from 20% to 80%) and potential impact on short-term mortality and morbidity, hospital stay, increased

health-care cost and even long-term survival.<sup>[1-4]</sup> However, delirium goes undetected in three out of four cases in the absence of the use of structured diagnostic instrument.<sup>[5]</sup> Therefore, knowledge of occurrences and frequencies of specific clinical features can aid

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the critical care physician to make decision for further screening and diagnostic assessment.

Although multiple studies have focused on incidence and prevalence of delirium, there are only handful of studies which have focused on phenomenology/symptom profile of delirium in the intensive care unit (ICU) settings. A study from coronary care unit (CCU) reported alteration in the sleep-wake cycle as the most commonly encountered symptom but other cognitive and non-cognitive symptoms were also common.<sup>[6]</sup> Another study from ICU setting, which had included both syndromal and subsyndromal delirium, reported sleep-wake cycle disturbances and cognitive symptoms constituted the predominant presentation and the authors could differentiate between subsyndromal delirium and normalcy by the presence of these two aforementioned symptoms.<sup>[7]</sup> A study of patients admitted in respiratory intensive care unit (RICU) reported disturbance in attention and thought process abnormalities in all patients.<sup>[8]</sup>

In terms of motoric subtypes, studies have come up with contradictory findings with majority of the studies reporting hypoactive subtype to be the most common subtype,<sup>[8,9]</sup> whereas occasional study suggest that hyperactive subtype is the most common subtype.<sup>[6]</sup>

Delirium Rating Scale-Revised 98 (DRS-R 98) has been previously used for the assessment of phenomenology of delirium in ICU settings.<sup>[6,8]</sup> Memorial Delirium Assessment Scale (MDAS), another instrument devised for similar purpose has been seldom used in ICU delirium.<sup>[10,11]</sup> It is shorter than DRS-R 98 and it has a distinct item of “level of consciousness,” which is considered to be an important feature for diagnosis of delirium in Diagnostic and Statistical Manual-IV (DSM-IV).<sup>[12]</sup> However, DRS-R 98 does not have item specifically to assess the level of consciousness. Accordingly, it can be said that use of both DRS-R 98 and MDAS together can complement the assessment of delirium and broaden the assessment of delirium. Therefore, studying the symptom profile of delirium using both these instruments might give an inclusive overview.

Factor structures of DRS-R 98 in non-ICU setups have yielded 2–3 factor model.<sup>[13-16]</sup> A confirmatory factor analysis of DRS-R 98 consisted of pooled patients from different countries, found a two factor solution consisted of “core” and “non-core” (motor agitation, affective lability, delusion) domains.<sup>[17]</sup> Factor analysis of MDAS in patients with advance cancer has yielded 2-factor solution, namely, global cognitive and neurobehavioral were found.<sup>[11]</sup> The factor structure of these instruments in ICU patients has not been

evaluated thoroughly. The study involving the RICU patients showed that symptoms of delirium as assessed by DRS-R 98 symptoms yield 3 factors (cognitive factor, motoric factor, and the third factor represented by thought and language disturbances).<sup>[8]</sup> No other study has evaluated the factor structure of symptoms of delirium in patients admitted to various ICUs. Accordingly, the aim of this study was to explore the symptom profile/phenomenology of delirium using DRS-R 98 and MDAS and evaluating the factor structure of these scales in the ICU setup.

## METHODS

### Setting of the study

The study was carried out in a multidisciplinary tertiary care hospital and has various medical and surgical specialties. The research project was approved by the suitably constituted Ethics Committee of an institution (Intramural Ethics Committee) and it is conformed to the provisions of the declaration of Helsinki.

Written informed consent was obtained from the family members of the patients before recruitment.

Over the last one decade or so, many ICUs have come up in the institute, such as respiratory ICU, liver ICU, gastroenterology ICU, cardio thoracic and vascular surgery ICU, neurosurgery ICU, urology ICU, burn ICU, pediatric ICU, and neonatal ICU. These ICUs are managed by the physicians/surgeons of the concerned specialty. However, the main ICU, in which this study was conducted, is one of the oldest ICUs, which is managed by the Department of Anesthesia and Intensive Care. This 12-bedded facility provides ICU care to the patients from all the medical and surgical departments. A patient is admitted to the main ICU is cared by the anesthesiologists in liaison with the primary treating team. On stabilization of clinical status, the patient is shifted out of the ICU and care is provided by the primary treating team alone.

### Sampling

Consecutive patients admitted to the main ICU from February 2013 to June 2013 formed the study cohort. To be included in the study, the patients were required to be aged 16 years or more. Informed consent was obtained from the family caregivers and in case family member refused to provide written informed consent they were not included in the study. All the patients were assessed between 5 and 8 pm daily on Richmond Agitation and Sedation Scale (RASS) to assess the level of sedation and agitation. Those patients found to be arousable (−3 to +4) were screened using confusion assessment method for ICU (CAM-ICU) for the presence of delirium. Those patients who screened

positive for delirium on CAM-ICU were further assessed by a qualified psychiatrist for the diagnosis of delirium as per the Diagnostic and Statistical Manual-4<sup>th</sup> Edition Text Revision (DSM-IV-TR) diagnostic criteria.<sup>[18]</sup> Amended delirium motor checklist was used to assess the type of delirium (hyperactive, hypoactive, or mixed). The ICU team was informed about those found to have delirium for appropriate management and all the assistance was provided by the psychiatrists involved in the study in the management of cases. The data pertaining to incidence and prevalence of the study sample have already being published earlier.<sup>[19]</sup> In this paper, we focus on the phenomenology of delirium.

### **Instruments for the prospective arm of the study**

#### *Richmond Agitation and Sedation Scale*

It is a 10-point scale with 4 levels to assess the anxiety or agitation (+1 to +4), one level to denote a calm and alert state (0) and 5 levels to assess the level of sedation (-1 to -5). A score of -4 indicates that the patient is unresponsive to verbal stimulation and finally, culminating in unarousable states (-5). It has good interrater reliability and validity.<sup>[20]</sup>

#### *Confusion assessment method for intensive care unit*

CAM-ICU can be used in patient arousable to voice without the need for physical stimulation. According to CAM-ICU, delirium is diagnosed when patients exhibits: (1) an acute change in mental status or fluctuating changes in mental status, (2) inattention, and either (3) disorganized thinking or (4) an altered level of consciousness. It has a minimum of 93% sensitivity and 89% specificity for detecting delirium in comparison to full DSM-IV assessment. When administered by a trained health-care professional, the CAM-ICU takes only 1–2 min.<sup>[21]</sup>

#### *Diagnostic and Statistical Manual-4<sup>th</sup> Edition Text Revision criteria for delirium*

DSM-IVTR criteria for delirium are considered to be standard criteria for making the diagnosis of delirium.<sup>[18]</sup>

#### *Delirium Rating Scale–Revised 98*

This scale was used to assess the phenomenology and severity of delirium. It has 13 items to assess the severity and 3 diagnostic items, pertinent to the preceding 24 h. The severity ratings range from 0 to 3 indicating no impairment to severe impairment and higher scores indicating higher severity of delirium. It is a well-validated instrument with high interrater reliability, sensitivity, and specificity.<sup>[22]</sup>

#### *Memorial Delirium Assessment Scale*

It is a physician-rated instrument designed to measure the severity of delirium. It has 10 items which assesses disturbances in arousal and level of consciousness,

and several areas of cognitive functioning (memory, attention, and disturbances in thinking), and psychomotor activity. This is a four-point (0–3) Likert scale and requires about can be completed in 10–15 min. It has high interrater reliability (0.92), internal consistency (coefficient  $\alpha = 0.91$ ), and high correlation with the scores in the DRS (Spearman rank correlation = 0.88,  $P < 0.0001$ ), minimal status examination (Spearman rank correlation = 0.91,  $P < 0.0001$ ), and delirium severity as rated by the clinicians (Spearman rank correlation = 0.89,  $P < 0.0001$ ). MDAS is able to differentiate people with delirium and other cognitive dysfunction. It is also used for making diagnosis of delirium and a cutoff score of 13 has been shown to be useful.<sup>[10]</sup>

#### *Amended Delirium Motor Symptom scale*

The original Delirium Motor Symptom Scale (DMSS) has 11 items, with 4 items to characterize hyperactive subtype and 7 items to characterize hypoactive delirium. Each of the items is rated as present (1) or absent (0) based on the observation of patient's behavior in previous 24 h. Based on the frequency of various items, the person with delirium is characterized as hyperactive, hypoactive, mixed, or no subtype. In a study from our center, a reanalysis of delirium motor checklist using similar methodology in patients of delirium seen in CL services, 2 more items were added to DMSS, making it a 13-item scale with 5 items for assessment of hyperactivity and 8 items for hypoactivity. For this study, this amended DMSS was used for subtyping the delirium.<sup>[23]</sup>

### **Statistical analysis**

Statistical Package for Social Scientists (SPSS for Windows, Version 14.0. Chicago, SPSS Inc.) was used for the analysis of data. Mean and standard deviation with range were calculated for continuous sociodemographic variable (age at assessment) and clinical variables (duration of delirium time from first onset of symptoms to the assessment). Frequency and percentages were calculated for categorical sociodemographic variable (gender) and clinical variables (etiology, medications etc.). Chi-square test, Fisher's exact test, and *t*-test were used to compare various variables of different groups and subgroups. Significance was fixed at  $P < 0.05$ . Factor analysis of symptom items was carried out using a principal components analysis.

## **RESULTS**

During the study period, 124 patients were admitted to the ICU, of which 109 were included in the study. Fifteen patients were excluded from the study, of which 9 cases were aged  $< 16$  years and 6 cases were shifted out

of ICU or died before being approached for the study. Of the 109 patients assessed for the study, 43 patients remained comatose throughout their ICU stay and could not be assessed for delirium. Sixty-six patients were evaluated for delirium, of which 45 (68%) patients developed delirium at point of their ICU stay.

The mean age of the study sample was 40.9 (SD - 17.5) years. Males (62.4%) outnumbered the female patients. More than half (55.1%) of patients were educated beyond tenth standard. No significant difference emerged between the age of patients who could be assessed and those who remained comatose during the study period. Further, there was no difference in the age among those who developed delirium and who did not develop delirium during the study period [Table 1].

The mean Acute Physiology and Chronic Health Evaluation II (APACHE-II) score was 14.8 (SD-7.3), mean sequential organ failure assessment score was 4.3 (standard deviation [SD] - 3.3), and the Charlson comorbidity index was 0.89 (SD - 1.36). Compared to those who did not develop delirium, those who developed

delirium had significantly higher mean APACHE-II score and mean Charlson comorbidity index score.

**Phenomenology of delirium**

**Delirium Rating Scale-Revised 98**

All patients fulfilled the criteria of “acute onset of symptoms” and “presence of an underlying physical disorder” as per the DRS-R 98. Hundred percent patients had sleep-wake cycle disturbances, this was followed by motor symptoms (retardation - 80%; agitation - 73.3%). delusions (37.8%) and visuospatial abnormalities (33.3%) were seen in less number of patients. The mean DRS-R 98 severity score was 14.74 (SD - 6.12; range 7-31) and mean DRS-R 98 total score was 20.47 (SD - 6.47; range 11-37) [Table 2]. Nineteen subjects scored >15 in DRS-R 98 severity score, 17 patients scored between 10 and 15, and 9 subjects scored <10.

**Memorial Delirium Assessment Scale**

As per MDAS assessment, all the subjects had disturbances in the consciousness, and all patients had disturbances in the sleep-wake cycle. Majority of the patients had attention problems (93.3%) and motor symptoms (93.3%).

**Table 1: Demographic and clinical characteristics of patients**

	n (%) / mean (SD)			Delirium versus no delirium, Student's t/χ <sup>2</sup> (significance)
	Total patients enrolled (n=109)	Developed delirium (n=45)	Remained delirium free (n=21)	
Age	40.9 (17.5)	40.7 (18.3)	39.7 (14.3)	0.47 (0.640)
Male gender	68 (62.4)	32 (71.2)	10 (47.7)	3.41 (0.065)
Age >60 (years)	23 (21.1)	11 (24.4)	3 (14.3)	0.884 (0.52)
Educated above 10 <sup>th</sup>	60 (55.1)	25 (55.6)	13 (62)	0.23 (0.627)
Patients belonging to medical specialty	73 (67)	32 (71.2)	16 (76.2)	0.18 (0.666)

SD – Standard deviation

**Table 2: Frequency and severity of various symptoms as assessed on Delirium Rating Scale-Revised 98**

	Symptom frequency, n (%)	Moderate/severe, frequency of symptoms (%)	Mean score±SD
Sleep-wake cycle disturbances	45 (100)	39 (86.7)	2.01±0.54 (1-3)
Perceptual disturbance	22 (48.9)	7 (15.6)	0.71±0.90 (0-3)
Delusions	17 (37.8)	5 (11.1)	0.51±0.95 (0-3)
Lability of affect	29 (64.4)	15 (33.3)	1.04±0.46 (0-3)
Language	19 (42.2)	8 (17.8)	0.67±0.93 (0-3)
Thought process abnormality	24 (53.3)	10 (22.2)	0.80±0.89 (0-3)
Motor agitation	33 (73.3)	20 (44.4)	1.22±0.90 (0-3)
Motor retardation	36 (80)	25 (55.6)	1.44±0.92 (0-3)
Orientation	38 (84)	31 (68.9)	1.69±0.93 (0-3)
Attention	44 (97.8)	40 (88.9)	2.29±0.73 (0-3)
Short-term memory	29 (64.4)	21 (46.7)	1.18±1 (0-3)
Long-term memory	18 (40)	3 (6.7)	0.49±0.69 (0-3)
Visuospatial ability	15 (33.3)	11 (24.4)	0.64±1 (0-3)
Temporal onset of symptoms	-	-	2.01±0.70 (1-3)
Fluctuation	-	-	1.24±0.48 (1-3)
Physical disorder	-	-	1.65±0.47 (1-2)
Mean DRS-R98 severity score			14.74±6.12 (7-31)
Total DRS-R98 score			20.47±6.47 (11-37)

DRS-R98 – Delirium Rating Scale-Revised 98; SD – Standard deviation

**Table 3: Frequency and severity of various symptoms as assessed on Memorial Delirium Assessment Scale**

	Symptom frequency, <i>n</i> (%)	Moderate/severe, frequency of symptoms (%)	Mean score±SD
Reduced level of consciousness (awareness)	45 (100)	40 (88.9)	2.11±0.57 (1-3)
Disorientation	39 (86.7)	27 (60)	1.56±0.84 (0-3)
Short-term memory impairment	29 (64.4)	22 (48.9)	1.16±0.95 (0-3)
Impaired digit span	32 (71.1)	20 (44.4)	1.27±1 (0-3)
Reduced ability to maintain and shift attention	42 (93.3)	32 (71.1)	1.93±0.89 (0-3)
Disorganized thinking	21 (46.7)	10 (22.2)	0.71±0.87 (0-3)
Perceptual disturbance	19 (42.2)	5 (11.1)	0.58±0.81 (0-3)
Delusion	17 (37.8%)	5 (11.1%)	0.31±0.95 (0-3)
Reduced or increased psychomotor activity	42 (93.3)	30 (66.7)	1.71±0.76 (0-3)
Sleep-wake cycle disturbance	43 (95.6)	35 (77.8)	1.80±0.63 (0-3)
Total MDAS score			13.33±4.03 (3-27)

MDAS – Memorial Delirium Assessment Scale; SD – Standard deviation

Delusions were less frequently (37.8%) seen. Mean MDAS score was 13.33 (SD - 4.03; range 3–27). Twenty-six subjects scored 13 or more in MDAS [Table 3].

**Motor subtypes**

As per the amended DMSS, the most common motoric subtype of delirium was hypoactive subtype (*n* = 21, 47% of the cases) of delirium and this was followed by the mixed subtype (*n* = 13, 29%) and hyperactive subtype (*n* = 11, 24.5%) subtype of delirium.

**Factor analyses of data**

Three-factor analyses were carried out. The first-factor analysis included 13 severity items of DRS-R 98, second factor analysis included items of MDAS scale, and the final factor analysis included extended list of symptoms, i.e., all the items of DRS-R 98 and additional items covered in MDAS but not in DRS-R 98.

**Factor analysis of Delirium Rating Scale–Revised 98**

Principal component factor analyses (PCA) were carried out using the 13 severity items of DRS-R 98. The Kaiser-Meyer-Olkin measure of sampling adequacy value was 0.734 and the Bartlett’s test of sphericity was significant (Chi-square 237.64, *df* = 78; *P* < 0.001). The principal component analysis with Varimax rotation with a three-factor solution could explain 61.26% variance. Three factors had Eigen value >1 and scree plot examination showed tailing at 3 factors. Perceptual disturbance, delusions, lability of affect, language, thought process abnormality, short-term memory, long-term memory, and visuospatial ability loaded on the first factor; motor agitation, and retardation loaded on the second factor. The items loaded on to the third factor included sleep-wake cycle disturbances, orientation, and attention. These three factors could be labeled as cognitive-psychotic, motor, and arousal-attention factors, respectively. When a 2-factor solution was evaluated, it could explain 50.7% of variance.

**Table 4: Factor analysis of Delirium Rating Scale-Revised 98**

DRS-R98 items	Three factor model			Two factor model	
	Factor-1	Factor-2	Factor-3	Factor-1	Factor-2
Sleep-wake cycle disturbances			0.669		0.685
Perceptual disturbance	0.542			0.537	
Delusions	0.727			0.715	
Lability of affect	0.603			0.621	
Language	0.837			0.840	
Thought process abnormality	0.785			0.786	
Motor agitation		0.878			0.853
Motor retardation		-0.858			-0.721
Orientation			0.585	0.373	
Attention			0.834		0.323
Short-term memory	0.805			0.802	
Long-term memory	0.660			0.633	
Visuospatial ability	0.704			0.730	

DRS-R98 – Delirium Rating Scale-Revised 98

Moreover, the communality values for attention and orientation, after Varimax rotation, were <0.5. Because of these reasons, two-factor solution of DRS-R 98 was discarded [Table 4].

**Factor analysis of Memorial Delirium Assessment Scale**

PCA with Varimax rotation was also carried out with 10-item MDAS. The Kaiser-Meyer-Olkin measure of sampling adequacy value was 0.535 and the Bartlett’s test of sphericity was significant (Chi-square 158.79, *df* = 45; *P* < 0.001). Three factor solution could explain 64.68% variance. Both by Eigen value calculation and Scree plot examination, three-factor solution was found to be acceptable. Short-term memory impairment, impaired digit span, and disorganized thinking loaded on to the Factor 1. Factor 2 consisted of reduced ability to maintain and shift attention, reduced or increased psychomotor activity, and sleep-wake cycle disturbance. The third factor included items of disorientation, perceptual disturbance, and delusion.

These three factors could be labeled as core-cognitive, arousal-attention, and noncore-cognitive, respectively. A two-factor solution was also generated, which could explain 51.04% of the variance. In addition to short-term memory impairment-impaired digit span-disorganized thinking, perceptual disturbance, and delusion loaded on to the first factor in the 2-factor solution. The second factor contained all other items. However, the communality value for the item disorientation was <0.5. Hence, it was excluded. Because of these reasons, three factor solution was found to be more suitable [Table 5].

**Factor analysis of combined Delirium Rating Scale and Memorial Delirium Assessment Scale**

Three items from MDAS, namely, reduced level of consciousness, impaired digit span, and reduced ability to maintain and shift attention were incorporated to the DRS-R 98. One item related to attention impairment was dropped from the DRS. After Varimax rotation factor analysis of this amalgamated items generated a three-factor solution which could explain 56.3% of variance. Perceptual disturbance, delusions, lability

of affect, language, thought process abnormality, short-term memory, long-term memory, visuospatial ability, and impaired digit span loaded on to the first factor. Factor 2 consisted of motor symptoms. Sleep-wake cycle disturbances, reduced level of consciousness, and reduced ability to maintain and shift attention were loaded in the third factor [Table 6]. Because of communality value <0.5, item-orientation had to be excluded. These three factors could be labeled as cognitive-psychotic, motor and arousal-attention, respectively.

**DISCUSSION**

Our study examined the phenomenology of delirium in an ICU setting which caters to both the medical and surgical patients, suggestive of a mixed etiological profile. Because of limitation of use of DRS-R 98 for ICU patients,<sup>[24]</sup> we additionally used MDAS for assessment of symptoms. According to DRS-R 98, among non-cognitive symptoms, sleep-wake cycle abnormalities was most common and visuospatial

**Table 5: Factor analysis of Memorial Delirium Assessment Scale**

MDAS items	Three factor model			Two factor model	
	Factor-1	Factor-2	Factor-3	Factor 1	Factor 2
Reduced level of consciousness (awareness)		0.675			0.766
Disorientation			0.641		0.448
Short-term memory impairment	0.837			0.807	
Impaired digit span	0.931			0.782	
Reduced ability to maintain and shift attention		0.654			0.619
Disorganized thinking	0.767			0.774	
Perceptual disturbance			0.735	0.703	
Delusion			0.800	0.533	
Reduced or increased psychomotor activity		0.655			0.595
Sleep-wake cycle disturbance		0.799			0.782

MDAS – Memorial Delirium Assessment Scale

**Table 6: Factor analysis of Delirium Rating Scale and Memorial Delirium Assessment Scale combined**

Variables	Three factor model (56.3%)			Two factor model (46.8%)	
	Factor-1	Factor-2	Factor-3	Factor-1	Factor-2
Sleep-wake cycle disturbances			0.680		0.710
Perceptual disturbance	0.546			0.607	
Delusions	0.718			0.765	
Lability of affect	0.603			0.661	
Language	0.810			0.818	
Thought process abnormality	0.670			0.762	
Motor agitation		0.855			0.794
Motor retardation		-0.838			-0.629
Orientation	0.379		0.352	0.362	0.202
Short-term memory	0.817			0.782	
Long-term memory	0.626			0.614	
Visuospatial ability	0.751			0.734	
Reduced level of consciousness			0.723		0.433
Impaired digit span	0.526			0.517	
Reduced ability to maintain and shift attention			0.635		0.447

abnormality was the least common symptom observed in our patients. Inattention was the most common cognitive symptom. Studies on phenomenology, from a palliative care inpatient service, and from a CCU also suggest which were quite similar to the present study.<sup>[6,25]</sup> The phenomenological presentation is similar to patients recruited from medical oncology and palliative care.<sup>[26]</sup> Replication of similar symptom profile in our study suggests generalizability of results, across etiologies, and across settings. Reduced level of consciousness, inattention, and sleep cycle alteration were the three most common symptoms, as measured by MDAS. Clouding of consciousness was one of the core features of delirium till DSM-IV, but it has been dropped in DSM-5 because of the supposed difficulty to assess it objectively.<sup>[27]</sup> An overt emphasis was given on attention. Consciousness is said to be the sum total of attention and arousal.<sup>[28]</sup> From our study, it is apparent that consciousness could be assessed reliably and along with its components, it constitutes the major phenomenology of delirium.

Major subtype of delirium, as found in our study, was hypoactive delirium. This result is comparable with the previous studies conducted in ICU setup.<sup>[9,29]</sup> However, we have used more validated and comprehensive instrument for subtyping, which should increase the robustness of our finding.

Factor analysis of DRS-R98 revealed 3-factor solution, namely, the cognitive-psychotic factor (language, thought, delusion, perceptual disturbances, memory, and visuospatial impairment), motor factor (motor agitation and retardation), and the arousal-attention factors (sleep-wake cycle disturbances, inattention, and disorientation). These three factors closely resemble the diagnostic criteria laid down in ICD-10, except the sleep-wake cycle alteration which has been mentioned separately in ICD-10.<sup>[30]</sup> Conceptually, sleep-wake cycle disturbances depict impaired arousal.<sup>[10]</sup> Therefore, its loading with attention and orientation makes intuitive sense. Previous factor analytic studies by using DRS/DRS R98 have found either a three factor (global cognitive-sleep and motor-thought, and language)<sup>[13]</sup> or two factor solutions, namely, cognitive and behavioral domains<sup>[15,16]</sup> or core (cognitive, language, thought, sleep-wake cycle abnormalities, and motor retardation), and non-core domains (delusion, perceptual disturbances, affect lability, and motor agitation).<sup>[17]</sup> The former studies recruited patients from the medical-surgical wards, and the latter was a confirmatory factor analysis, conducted from a pooled database of patients from both outpatient and inpatient care. The locus of the present study was ICU where the underlying etiology for delirium might be

different. Perhaps, this would explain different factor solutions in our study.

The factor analysis of MDAS also revealed a three-factor model. These are core-cognitive (memory, language), attention-arousal-motor (reduced awareness, inattention, altered sleep-wake cycle, motor symptoms), and non-core cognitive (delusion, perceptual disturbances, and disorientation) factor. This is different from the three-factor solution of DRS, which has one single cognitive domain. There is only modest agreement among some of the items (attention, thought abnormalities) of MDAS and DRS and the sensitivity, specificity, and discriminative power for the diagnosis of delirium are also different.<sup>[26,31,32]</sup> These might explain the difference in the factor solution. A study from India, on factor analysis of MDAS found a two-factor model, namely, cognitive (memory, disorientation, and attention) and behavioral (altered psychomotor activity, though and sleep-wake cycle abnormalities, reduced awareness).<sup>[11]</sup> Although the authors included delusion and perceptual disturbances in the behavioral factor, a close observation revealed communality values for these items to be <0.5, suggestive of inadequate loading on that particular factor. Another study from Italy also demonstrated a two-factor model of MDAS.<sup>[32]</sup> Both these studies had smaller sample sizes and none of them were conducted in ICU patients.

Finally, factor analysis of combined DRS-R98 and MDAS showed results, almost similar to the factor models of DRS-R98, consisted of cognitive-psychotic domain (language, thought, delusion, perceptual disturbances, memory, and visuospatial impairment), motor, and attention-arousal (reduced awareness, inattention, altered sleep wake cycle) domains. From all three factor analysis, it is quite apparent that attention-arousal is a distinct factor and there could be overlap between cognitive-behavioral domains. Attention-arousal factor depicts the core criterion for delirium, “clouding of consciousness” in DSM-III and IV and “inattention” in DSM-V. Our study has reiterated the importance of this core symptom of delirium.

This study results should be interpreted in light of the following limitations. Our study reflects the characteristics and outcome from a general purpose ICU which caters patients from multiple specialties. Furthermore, the present study represents findings from a single center. Hence, the results may not be generalizable to specialty ICU setting or general medicosurgical wards. The assessment for delirium was done once daily, and hence, transient episodes of delirium could have been missed. The study was limited

to a relatively small sample size and future studies involving larger sample size are warranted.

## CONCLUSION

To conclude, our study suggests that phenomenology of delirium in ICU setting is similar to that of the non-ICU settings, but hypoactive delirium is more common as opposed to hyperactive subtype in the non-ICU. The factor analysis consistently demonstrated a three-factor solution, with a robust attention-arousal factor, and overlapping cognitive (core vs. noncore)-behavioral factors.

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## Conflicts of interest

There are no conflicts of interest.

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