Effects of a Multicomponent Intervention Program for Preventing Delirium in Geriatric Patients in the Intensive Care Unit

Hwang, Ju Hee1· Kim, Min Young2

1Master’s Degree, Instructor, College of Nursing, Jeju National University, Jeju, Korea
2Ph.D., Professor, College of Nursing, Health and Nursing Research Institute, Jeju National University, Jeju, Korea

Purpose: This study aimed to investigate the effects of a Multicomponent Intervention Program for Preventing Delirium (MIPPD) on the incidence of delirium, self-extubation or self-removal of the catheter, and length of stay among elderly patients in the Intensive Care Unit (ICU). Methods: This study employed a nonequivalent control group pretest-posttest non-synchronized design to verify the MIPPD effects. The participants, 73 patients aged over 65 years were admitted to a university hospital's ICU in J province between December 2015 and July 2016. The MIPPD contained the following elements: family caregiver education, delirium assessment, reorientation activities, therapeutic communication, sensory intervention for vision and hearing impairments, management of immobility or limited mobility, family support, and maintenance of sleeping patterns. Under the program, nurses and family members provided immediate intervention to elderly patients with an expected length of stay of at least 48 hours. Results: After the MIPPD application, the incidence of delirium in the intervention group was significantly lower (odds ratio=0.19, 95% confidence interval=0.03~0.97) than that in the control group. However, there were no significant differences between the groups in terms of self-extubation or catheter self-removal and length of stay. Conclusions: This program can effectively reduce the incidence of delirium. Because prevention is optimal for delirium management, a proactive intervention must be considered; given that, in this study, there were no problems in terms of family engagement, an MIPPD involving family participation should be actively implemented in intensive care unit practice.

Key Words: Delirium; Aged; Intensive care units; Family

INTRODUCTION

Delirium is an acute, transient organic brain syndrome characterized by cognitive dysfunction, altered consciousness and attention, increased or decreased mental activity, and sleep disturbances [1]. The etiology of delirium is multifactorial and complex, and its risk increases with disease severity [2]. Delirium, especially among elderly patients, can lead to negative consequences including falls, dysfunction, prolonged Length of Stay (LOS), discharge to a long-term care facility [3], decreased health-related quality of life [4], and persistent cognitive impairment [5]. In South Korea, the incidence rate of delirium among elderly patients was 6.2% in the general ward [6] and 27.2~63.0% in the Intensive Care Unit (ICU) [7,8]; however, delirium prevalence in the ICU can reportedly increase up to 80% in other countries [9].

Geriatric patients in the ICU often become conscious of their disease progression as they undergo various invasive or non-invasive treatments in the unfamiliar ICU and experience psychological imbalances (e.g., anxiety) while simultaneously dealing with the death of other patients [10]. Because older adults have a relatively lower reserve capacity for normal functioning than their younger counterparts [11], proper care must be taken to prevent the occurrence of delirium among older patients. In particular,
delirium among ICU patients is often accompanied by an increase in unplanned extubation or catheter removal and a decrease in the mean number of ventilator-free days, which, in turn, leads to an increased LOS and a decreased survival rate [12,13]. While it is important to prevent adverse events such as unplanned extubation and catheter removal by preventing delirium, research on delirium prevention interventions that considers these aspects is limited.

Delirium management must focus on prevention and early detection rather than on post-hoc treatment [9]. Under the 2010 National Institute for Health and Clinical Excellence recommendations for delirium intervention, all adult ICU patients must be regularly assessed for delirium once per shift using assessment tools such as the Confusion Assessment Method for the ICU (CAM-ICU) for early detection [14]. However, even though 91.5% of nurses had attended to a patient with delirium, 88.4% reportedly subjectively evaluated patient delirium based only on clinical symptoms [15]. ICU quality management has been recommended for sedation improvement, pain relief, and delirium protocols, including patient assessment methods used in South Korea, since 2014 (Health Insurance Review and Assessment Service, 2014). However, in some cases, protocols have not been carried out in institutions because of insufficiency of nurses. For example, the sedation management protocol was applied in the medical institution where this study was conducted, but delirium assessment was not. This situation leaves room for improving the documentation of delirium symptoms in an organized manner. Furthermore, while elderly and ICU patients tend to show higher delirium incidence, most studies on ICU patients do not distinguish between age groups [16,17], and research on preventive interventions specifically for older ICU patients has been rare. Although family engagement as a preventive intervention can be helpful [2,18], few studies have examined interventions involving family members. This situation could be attributed to certain restrictions on ICU visits, as, under most medical institutions’ rules, most units are required to minimize access and limit the duration and number of such visits [19,20].

While ICU nurses are most suited for applying preventive delirium interventions, families can influence patients’ response and sense of security and hope during severe illnesses [21]. In particular, because family members share patients’ lives, they can contribute toward strengthening orientation by talking about the patients’ hobbies, occupations, and interests. Hence, it is reasonable to consider engaging nurses as well as patients’ families when designing a delirium prevention intervention program.

This study investigates a Multicomponent Intervention Program for Preventing Delirium (MIPPD) that targets elderly ICU patients and involves nurses and patients’ family members, and its effects on delirium incidence, self-extubation or self-removal of catheter, and LOS.

1. Study Design

A nonequivalent control group pretest-posttest non-synchronized design was employed to verify the MIPPD effects.

2. Setting and Samples

The participants included elderly patients aged ≥65 years, admitted to one ICU of a university hospital located in J Province, South Korea, between December 2015 and July 2016. The patient inclusion criteria were as follows: being elderly without delirium at the initial assessment and lacking any communication difficulties or cognitive problems. Written informed consent was obtained from the patients. Informed consent was obtained from the patient’s family caregiver if the patient did not have the competence to provide informed consent. The exclusion criteria included a score of −4 or less on the Richmond Agitation and Sedation Scale (RASS); dementia; any psychiatric or neurological diagnosis; any primary brain lesions of the vascular, traumatic, malignant, or infectious type; a period of continuous intravenous sedation; and absence of a guardian. Considering that effect size greater than 1 in a previous study on intervention effects in postoperative ICU care [22], we calculated the sample size using effect size d=0.80, significance level α =.05, and power 1-β=.80. We used G*Power 3.1.7, which yielded a result of 26 per group, or 52 per study.

The inclusion criteria for family caregivers were as follows: family members who could make three visits per day. At least one family member per patient was required to participate in family support after provision of informed consent. Nurses were selected from among ICU nurses who had agreed to participate in the study.

3. Ethical Considerations

This study was approved by the Institutional Review Board of the J Hospital (Approval No. 2015-09-010). The research procedures were carefully planned to protect participants’ human rights and privacy. Participants were
assured that their anonymity would be protected. All participants provided informed consent and voluntarily participated in this study after researchers explained the study and their right to withdraw.

4. Measurements

1) Demographic and medical information
   The researcher and five Research Assistants (RAs) used electronic medical records to survey the following: two items for general characteristics (gender and age), nine risk factors (disease severity, number of underlying diseases, fractures, visual impairment, hearing impairment, infection, pain, immobility, and sleep disorder), and six treatment characteristics (use of physical restraint, endotracheal intubation/tracheostomy, ventilator use, number of catheters, painkiller use, and hypnotics use) in both groups at the time of admission in both groups.

2) Delirium occurrence
   We employed the Korean version of the Confusion Assessment Method for the ICU (CAM-ICU) [23], a tool for evaluating delirium among ICU patients, after obtaining permission from the developer of the tool to use it. The CAM-ICU includes assessments of sedation levels and delirium. The level of sedation was measured using the RASS [24], a 10-point scale ranging from -5 (unconsciousness) to +4 (combative). If the score is \( \leq -4 \), the assessment process should be paused and resumed later. If the score is \( \geq -3 \), the process moves to delirium assessment. The nurse performed the delirium diagnosis using four clinical features: 1) change in mental status, 2) inattention, 3) disorganized thinking, and 4) altered level of consciousness. Features 1 and 2 as well as Feature 3 or 4 should be present to meet the delirium criteria. In this study, delirium was assessed three times a day (total: six times) for 48 hours immediately after admission to the ICU by the researcher and RAs. If the result was positive at least once during these 48 hours, we determined the case to be one of delirium.

3) Self-extubation or self-removal of the catheter
   The researcher and RAs measured the number of times the patient removed any endotracheal tube or catheters in an unplanned manner during the 48 hours after the baseline assessment.

4) ICU LOS
   We calculated the total length of ICU stay (in hours) from the day of ICU admission to the day of discharge when the patient was stabilized and transferred to the general ward.

5. Intervention

The MIPPD was developed based on the following references: the National Clinical Practice Guidelines [14], the delirium prevention program by Inouye et al., which targeted six risk factors for delirium (cognitive impairment, visual impairment, hearing impairment, dehydration, immobility, and sleep deprivation) [25], and the family participation program by Rosenbloom-Brunton et al. [18]. An expert group was organized for verifying the developed MIPPD’s content validity: one psychiatrist, one intensive care specialist, one nursing professor, two ICU head nurses, one ICU charge nurse, and four ICU nurses with more than 10 years of clinical experience. Appropriateness and applicability of the procedure of the MIPPD were evaluated, and the program was confirmed with a Content Validity Index (CVI) of .80 or higher.

The program included participation from nurses and family members in order to provide immediate intervention during the 48-hours ICU admission, thus preventing the outbreak of delirium among elderly ICU patients. The intervention package contained the following elements: (1) family caregiver education, (2) delirium assessment, (3) reorientation activity, (4) therapeutic communication, (5) sensory intervention for vision/hearing impairments, (6) management of immobility or limited mobility, (7) family support, and (8) maintenance of sleeping patterns (Table 1). The nurses used the MIPPD checklist to ensure accurate and consistent intervention during the 48 hours.

1) Family caregiver education:
   Upon ICU admission, researchers and RAs identified the family/caregivers who would participate in the intervention and trained them to understand the following aspects of care: the definition, symptoms, etiology, negative effects, and prevention of delirium and the orientation reinforcement intervention they would participate in. Moreover, we scheduled one additional intervention-related visit in addition to the two-daily visits set by the hospital guidelines.

2) Delirium assessment:
   The staff nurses assessed the occurrence of delirium using the CAM-ICU once per shift (8 AM/4 PM/11 PM).

3) Reorientation activity:
   The staff nurses assessed the patient’s orientation at a
Table 1. Multicomponent Intervention Program to Prevent Delirium

| Date       | Theme                                | Contents                                                                                                                                                                                                 | Time                                      |
|------------|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| D1         | Family caregiver education           | - Assess educational needs and decision of primary family caregiver.  
- Educate the family caregiver on the definition, symptoms, etiology, negative effects, prevention of delirium, and the orientation reinforcement intervention that the family caregiver would take part in.  
- Schedule the additional visit time.                                                                                                                 | Upon ICU admission                        |
| D1~D2      | Delirium assessment                  | - Assess the occurrence of delirium using CAM-ICU once per shift.                                                                                                                                       | 8 AM/4 PM/11 PM                           |
| D1~D2      | Reorientation activity               | - Assess the patient’s orientation every 2 hours at least.  
- Inform the patient of the date, time, and place (using whiteboard and clock).  
- Explain the reason for hospitalization and the treatment process.                                                                                   | Frequently during Day/Evening shift       |
| D1~D2      | Therapeutic communication            | - Maintain clear and open communication with the patient and encourage emotional expression.  
- Introduce yourself to the patient with common greetings and always used the patient's name when communicating.  
- Allow the patient to express his or her thoughts and feelings on familiar topics such as hobbies, occupations, and family.  
- Try to be aware of the patient's mood and encouraged verbal expression while constantly maintaining eye contact, nodding his or her head, and speaking in a warm, friendly manner. | At least every 2 hours during Day/Evening shift |
| D1~D2      | Sensory intervention for vision/hearing impairments | - Assess visual and hearing impairments.  
- Provide glasses or hearing aids if required.  
- Provide the patient's daily items or photographs from home at the bed side.                                                                        | Frequently during Day/Evening shift       |
| D1~D2      | Management of immobility or limited mobility | - Allow to move freely on bed within the safety.  
- Minimize the use of restraint. Even when restraints were applied to the patient, check the condition of the restraint area and try to reduce the restraint time as much as possible.  
- Minimize unnecessary catheters or venous lines.                                                                                                     | Frequently during Day/Evening shift       |
| D1~D2      | Family support                       | - Provide reorientation activity (person, place, and time)  
- Talk about familiar topics of interest such as family matters, patient's hobbies, or job and current events.  
- Discuss about the patient's experience during hospitalization, examination, surgery, etc.                                                        | 9 AM/7 PM/9 PM (for 30 minutes)           |
| D1~D2      | Maintenance of sleeping patterns      | - Assess sleep disturbing factors.  
- Provide an indirect lighting of approximate intensity of 50~80 Lux.  
- Provide eye mask or ear plugs if required.  
- Adjust the medication regimen to avoid it in the time between midnight and 5 AM.                                                                  | Frequently during Night shift             |

CAM-ICU=confusion assessment method for the intensive care unit; D1=the first day of admission; D2=second day after admission; ICU=intensive care unit.

minimal interval of every 2 hours and informed the patient about the date, time, and place. The clock’s location within the ICU was also explained to the patient, and a whiteboard with information on the date, reason for hospitalization, and surgery/examination were installed in the ICU.

4) Therapeutic communication:
The staff nurses tried to maintain clear and open communication with the patient and encouraged emotional expression. At the start of each shift, the nurse introduced himself or herself to the patient and always used the patient’s name during communication. To provide a sense of
stability, the nurse asked several open-ended questions that allowed the patient to express his or her thoughts and feelings on familiar topics such as hobbies, occupations, and family. While communicating with the patient, the nurse tried to remain aware of the patient’s mood and encouraged verbal expression by constantly maintaining eye contact, nodding his or her head, and speaking in a warm, friendly manner. Clear and simple instructions were provided to the patient, slowly and repetitively. The patient with intubation used a call bell to request assistance and a whiteboard to communicate in writing. Furthermore, the nurses carefully made eye contact and checked the patients’ facial expressions. To facilitate consistent intervention application, RAs ensured that the staff nurses provided good therapeutic communication during each shift.

5) Sensory intervention for vision/hearing impairments:
At admission, the nurse identified whether the patients used glasses or hearing aids and provided these materials at their bedside; thus, if required, each patient could access them. The patient’s daily personal care items from home or photographs of the patients, their family and friends were also provided.

6) Management of immobility or limited mobility:
Patients were allowed to move freely within safety rules, and the use of physical restraints and unnecessary catheters or venous lines was minimized. The staff nurses tried to avoid restraint application. Even when restraints were applied to the patient, the nurse checked the condition of the restraint area at each shift and tried to reduce the time that the patient spent in restraints as much as possible; the nurse carried out this process not only when changing the position of the patients or applying the passive range of motion exercise but also during conversations with the patient. Any peripheral intravenous catheter that remained unused for more than one day was removed.

7) Family support:
Under a staff nurse’s supervision, the patient’s family caregivers provided family support three times a day. The family informed the patient about the date, time, and place, talked about familiar interesting topics such as family matters, the patient’s hobbies, or job and current events. The family caregiver also calmly discussed the patient’s experience during hospitalization, examination, or treatment. To facilitate consistent intervention application, the RAs monitored whether family support had been well established.

8) Maintenance of sleeping patterns:
At night, indirect lighting with an approximate intensity of 50~80 Lux was provided. The night shift nurse assessed sleep disturbance factors to enhance the quality of sleep, supplied the patient with an eye mask or ear plugs if required, and adjusted the medication regimen to avoid dosing between midnight and 5 AM.

6. Procedure

1) Preliminary test and nurse education
We first applied the program to one patient and a family caregiver from each of these age groups: 60s, 70s, and 80s; next, we conducted a preliminary investigation to examine the patients’ level of understanding of program contents, survey method, delirium assessment tool, and time required for the assessment and survey. RAs managed the therapeutic communication and family support interventions. RAs were nurses with more than 7 years of experience in the ICU; they were trained to manage the intervention program using the delirium assessment tool, therapeutic communication, and family support. To provide MIPPD, ICU nurses were trained to use the content of the eight elements of MIPPD, the delirium assessment tools, and the MIPPD checklist. On two occasions, the researcher conducted a training program over two weeks for ICU nurses. A total of 24 ICU nurses participated in this training program at least once; furthermore, additional education was provided to seven nurses in order to increase their understanding of the contents of the MIPPD or assessment process of delirium. The training duration was approximately 30~40 minutes.

2) Data collection
This study’s data were collected from December 2015 to July 2016. To prevent any diffusion of treatment effects, data collection for the control group was conducted between December 2015 and March 2016; after a 3-week interval, intervention and data collection for the intervention group were conducted between April 2016 and July 2016.

The researcher and RAs assessed the occurrence of delirium at the time of admission in both the control and intervention groups and collected demographic data, data regarding the relationships between patients and primary family caregivers, and medical data from their electronic medical records. Delirium occurrence was assessed in the two groups at least every 8 hours after the baseline assessment. Forty-eight hours after the baseline assessment, delirium occurrence and the number of instances of self-ex-
tubation or self-removal of the catheter were measured, and ICU LOS was measured at the time of discharge from the ICU in both groups.

3) Control group
The control group received the usual care. At the start of the shift, the staff nurses normally communicated with the patient; this included providing a general greeting and introducing oneself, and if necessary, confirming the patient’s orientation. Based on hospital policy, the control group was allowed to have 30 minutes, twice daily, of visits from family members or acquaintances; this group had free conversation in a natural atmosphere. During the visit, the nurse explained the patient’s treatment and test results and answered the caregivers’ questions. The nurse provided usual care, such as assessing fall risk, checking for any damages to the skin from the restraints, and managing noise control at night. In case of delirium occurrence, the clinician was contacted immediately for swift treatment.

4) Data analysis
We analyzed the collected data using the SPSS/WIN 21.0. Descriptive statistics were used to analyze the participants’ general and disease-specific characteristics. To test for homogeneity between the intervention and control groups, we performed the $\chi^2$ test, Fisher’s exact test, and the independent t-test. The Kolmogorov-Smirnov test was performed to verify normal distribution. Logistic regression and Mann-Whitney U tests were used for evaluating program effectiveness. The Hosmer-Lemeshow method was used to confirm the compatibility of each logistic regression by comparing the real value with the predictive value. A high score indicated a high compatibility of logistic regression. All statistical analyses were two-sided, and the significance level was set at .05.

RESULTS

1. Demographic Characteristics
We used G*power 3.1.7, which yielded a result of 26 per group, or 52 per study. However, during the study period, there were many dropouts because of unexpected ICU improvements. Finally, we recruited 112 participants (56 in the intervention group and 56 in the control group). Among these, 35 (19 in the intervention group and 16 in the control group) were excluded because they failed to receive all the interventions due to an ICU LOS of <48 hours. Two participants were excluded from the control group, as they moved into deep sedation (RASS score of -4) during their ICU stay. From the intervention group, one patient who had received continuous intravenous sedation for endotracheal intubation and another with no record of initial delirium assessment were excluded. Finally, we used the data of 73 participants for analysis: 35 in the intervention group and 38 in the control group (Figure 1). A post-analysis of whether the high dropout rate affected the power of the test showed that the study power was .90, which means that it was acceptable. Furthermore, an anal-

![Figure 1. Flow chart of the study process.](https://kjan.or.kr)
ysis of the dropout characteristics between the intervention and control groups showed that the general characteristics, delirium risk factors, and therapeutic characteristics were all homogeneous.

As shown in Table 2, 54.8% of the participants were women, the mean patient age was 76.38 years, and participants had 3.32 underlying diseases on average. In the diagnosis, 34.2% of the participants had an infection, and 16.4% had cancer. Approximately two-thirds of family caregivers were the patients' children. There was no sig-

### Table 2. Characteristics of Participants

| Variables                     | Categories | Total n (%) or M±SD | Intervention group (n=35) n (%) or M±SD | Control group (n=38) n (%) or M±SD | x² or t | p     |
|-------------------------------|------------|---------------------|----------------------------------------|------------------------------------|---------|-------|
| Gender                        | Men        | 33 (45.2)           | 15 (42.9)                              | 18 (47.4)                          | 0.15    | .699  |
|                               | Women      | 40 (54.8)           | 20 (57.1)                              | 20 (52.6)                          |         |       |
| Age (year)                    |            | 76.38±7.07          | 75.51±7.52                             | 77.18±6.64                         | -0.67   | .503  |
| Diagnosis                     | Infections | 25 (34.3)           | 15 (42.9)                              | 10 (26.3)                          | 5.20    | .157  |
|                               | Cancer     | 12 (16.4)           | 3 (8.5)                                | 9 (23.7)                           |         |       |
|                               | Fracture   | 7 (9.6)             | 2 (5.7)                                | 5 (13.2)                           |         |       |
|                               | Others †   | 29 (39.7)           | 15 (42.9)                              | 14 (36.8)                          |         |       |
| Number of comorbidity         |            | 3.32±0.94           | 3.29±0.78                              | 3.45±0.82                          | 4.04    | .258  |
| SAPS3                         |            | 40.32±15.20         | 43.51±13.60                            | 37.37±16.17                        | 1.75    | .085  |
| Visual disturbance            | Yes        | 7 (9.6)             | 4 (11.4)                               | 3 (7.9)                            | 0.26    | .703  |
|                               | No         | 66 (90.4)           | 31 (88.6)                              | 35 (92.1)                          |         |       |
| Hearing defect                | Yes        | 5 (6.8)             | 2 (5.7)                                | 3 (7.9)                            | 0.14    | .999  |
|                               | No         | 68 (93.2)           | 33 (94.3)                              | 35 (92.1)                          |         |       |
| Fracture                      | Yes        | 12 (16.4)           | 3 (8.6)                                | 9 (23.7)                           | 3.03    | .082  |
|                               | No         | 61 (83.6)           | 32 (91.4)                              | 29 (76.3)                          |         |       |
| Infection                     | Yes        | 29 (39.7)           | 16 (45.7)                              | 13 (34.2)                          | 1.01    | .316  |
|                               | No         | 44 (60.3)           | 19 (54.3)                              | 25 (65.8)                          |         |       |
| Pain                          | Yes        | 47 (64.4)           | 20 (57.1)                              | 27 (71.1)                          | 1.54    | .215  |
|                               | No         | 26 (35.6)           | 15 (42.9)                              | 11 (28.9)                          |         |       |
| Immobility                    | Yes        | 7 (9.6)             | 2 (5.7)                                | 5 (13.2)                           | 1.16    | .281  |
|                               | No         | 66 (90.4)           | 33 (94.3)                              | 33 (86.8)                          |         |       |
| Sleep disturbance             | Yes        | 2 (2.7)             | 2 (5.7)                                | 0 (0.0)                            | 2.23    | .135  |
|                               | No         | 71 (97.3)           | 33 (94.3)                              | 38 (100.0)                         |         |       |
| Use of physical restraint     | Yes        | 13 (17.8)           | 4 (11.4)                               | 9 (23.7)                           | 1.87    | .172  |
|                               | No         | 60 (82.2)           | 31 (88.6)                              | 29 (76.3)                          |         |       |
| Intubation or tracheostomy    | Yes        | 7 (9.6)             | 4 (11.4)                               | 3 (7.9)                            | 0.26    | .703  |
|                               | No         | 66 (90.4)           | 31 (88.6)                              | 35 (92.1)                          |         |       |
| Use of ventilation            | Yes        | 8 (11.0)            | 3 (8.6)                                | 5 (13.2)                           | 0.39    | .712  |
|                               | No         | 65 (89.0)           | 32 (91.4)                              | 33 (86.8)                          |         |       |
| Number of catheter            | Mean       | 3.37±0.80           | 3.29±0.78                              | 3.45±0.82                          | 3.23    | .358  |
| Use of painkiller             | Yes        | 39 (53.4)           | 15 (42.9)                              | 24 (63.2)                          | 3.02    | .082  |
|                               | No         | 34 (46.6)           | 20 (57.1)                              | 14 (36.8)                          |         |       |
| Use of sedatives              | Yes        | 2 (2.7)             | 0 (0.0)                                | 2 (5.3)                            | 1.89    | .494  |
|                               | No         | 71 (97.3)           | 35 (100.0)                             | 36 (94.7)                          |         |       |
| Primary family caregiver      | Spouse     | 20 (27.4)           | 11 (31.4)                              | 9 (23.7)                           | 0.61    | .737  |
|                               | Children   | 48 (65.8)           | 22 (62.9)                              | 26 (68.4)                          |         |       |
|                               | Daughter-in-law | 5 (6.8)           | 2 (5.7)                                | 3 (7.9)                            |         |       |

M=mean; SAPS3=simplified acute physiology score 3; SD=standard deviation; † Fisher’s exact test; ‡ Others include diabetes, trauma, metabolic abnormalities, acute renal failure and cardiac causes.
significant difference between the control and intervention groups in terms of delirium risk factors, including disease severity, visual/hearing impairment, immobility, and sleep disorders. Treatment characteristics, including drug use, ventilator use, and number of catheters and primary family caregivers, also showed no differences, confirming homogeneity between the two groups. Furthermore, analysis of the patients who withdrew in both the control and intervention groups revealed that they had the same characteristics.

2. Effects of MIPPD

We used logistic regression to analyze and evaluate MIPPD effects on the incidence of delirium and self-extubation or self-removal of the catheter. The Hosmer-Lemeshow method was used to confirm the compatibility of each logistic regression. All models were found to be compatible ($\chi^2=5.14, p=.076$).

After the MIPPD application, the incidence of delirium in the intervention group was significantly lower (Odds Ratio [OR]=0.19, 95% Confidence Interval [CI]=0.03–0.97, $p=.047$) than that in the control group, thus indicating that the incidence of delirium decreased by 81% after MIPPD application, which was a significant result. Delirium occurred in two patients (5.7%) in the intervention group and nine patients (23.7%) in the control group. The incidence of self extubation or self-removal of catheter was lower with no significant differences (OR=0.34, 95% CI=0.03–3.46, $p=.365$) between the groups (Table 3). The number of instances of self-extubation or self-removal of the catheter was one (2.9%) in the intervention group and three (7.9%) in the control group.

Evaluation of MIPPD effects on LOS (Table 4) revealed that ICU LOS in the intervention group was shorter than that in the control group (71.81 hours vs 93.93 hours), but the difference was insignificant ($Z=1.08, p=.282$).

## DISCUSSION

Delirium is generally known to be multifactorial and complex [14]; therefore, a multicomponent intervention that considers the complexity of the risk factors must be provided within 24 hours of admission [14]. Although an intervention that engages family members can be effective [2,18,26], it is not feasible to provide ICU patients with a program encompassing all these factors. Accordingly, this study developed an MIPPD involving nurses and families for elderly ICU patients at a high risk of delirium and analyzed its effects.

We succeeded in developing a nurse-led MIPPD that encompassed multiple factors and engaged family members for 48 hours post-admission. Although this intervention program targeted ICU patients, it was not difficult to engage family members in its functioning, as observed in the study published by Rosenbloom-Brunton et al. [18]. This implies that family participation can be actively encouraged and included in the design of delirium prevention interventions, even in environments with limited access (e.g., ICUs). However, in interventions involving family participation, members’ participation and contributions may vary, and it may be difficult to evaluate these aspects. Therefore, future studies must analyze the effects of the program based on the quality of family support and the characteristics of the family members.

This study’s results showed that the incidence of delirium in the intervention group was 0.19 times higher than that in the control group after MIPPD application. This in-
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CONCLUSION

This study targeted elderly ICU patients, who are at high risk of delirium and explored the characteristics of elderly patients in general and the various etiological factors of delirium in order to develop a nurse-led and family participation-supported MIPPD. This program effectively reduced the incidence of delirium. ICU nurses could adopt the checklist in clinical practice. Furthermore, it would require hospitals to change their policies (e.g., adding MIPPD in the job description of ICU nurses or expanding...
ICU visiting frequency and time in order to enhance family members’ role in preventing delirium. This study excluded some factors that could affect delirium, such as the administration of sedatives in a state of agitation or ventilator application in the ICU, during participant selection. Therefore, it is necessary to confirm the intervention program’s effectiveness while considering these treatment characteristics in future studies.

CONFLICTS OF INTEREST
The authors declared no conflict of interest.

AUTHORSHIP
Study conception and design acquisition - HJH and KMY; Data Collection - HJH; Analysis and interpretation of the data - HJH and KMY; Drafting and critical revision of the manuscript - HJH and KMY.

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