# Effect of Mother Voice on Physiological Parameters and Level of Consciousness of Patients in Pediatric Intensive Care Unit

**Asmaa Attia Tolba*[1], Fatmaa Elzahraa Kamal Elsayed [2], Amira Hassan Abdelfatah[3], Safaa Mahmoud Ahmed[4], Azza Ahmed Eltayeb[5], Sanaa Saber Mohamed [6].**

1. Lecturer of Critical Care & Emergency Nursing**,** Faculty of Nursing, Assuit University, Egypt.
2. Lecturer of Pediatric Nursing**,** Faculty of Nursing, Sohag University, Egypt.
3. Lecturer of Pediatric Nursing**,** Faculty of Nursing, Assuit University, Egypt.
4. Fellow of critical care nursing and emergency, Assiut University Hospitals, Egypt.
5. Professor and head of PICU Children university Hospital, Assiut University , Egypt
6. Lecturer of Critical Care & Emergency Nursing**,** Faculty of Nursing, Sohag University, Egypt.

**** Corresponding Author***: asmaa_atiaa2010@aun.edu.eg.

## Abstract

Reduction in sensory inputs is considered one of the most common complications following intensive care unit (ICU) admission. Changes in physiologic parameters are brought about by auditory stimulation, which hastens recovery. **So, this study aimed** to examine the effect of mother voice on physiological parameters and level of consciousness of patients in pediatric intensive care unit**. Research design and setting**: A quiz experimental study was carried out from beginning of March 2022 till end of October 2022 in pediatric ICU at Assiut University Children's Hospital, Egypt. **Sample**: A purposive sample of 60 patients was assigned into two equal groups: control and intervention groups. **Study tools:** Two tools were utilized to collect data: physiological parameters assessment sheet, and Glasgow Coma Scale. **Results:** The mother's voice had a statistically significant effect on oxygen saturation and level of consciousness in the intervention group compared to the control group at the 3rd day with (p.value < 0.05). While there was no statistical significant difference among the study groups as regard heart rate, systolic and diastolic blood pressure from the 1st to the 3rd day. **Conclusion:** Auditory stimulation utilizing the mother's voice has a significant effect on improving the level of consciousness and oxygen saturation in comatose pediatric patients. **Recommendations**: Replication of other studies utilizing multimodal stimulation (auditory, visual, and tactile stimulation) can be used either independently or in combination to examine its effect on several additional factors such as mechanical ventilation and length of stay.

**Keywords:** Mother Voice, Physiological Parameters, Level of Consciousness, Pediatric Intensive Care Unit.

## Introduction:

Loud noises, bright lights, and a reduction in stimulation create a very stressful environment for patients in the intensive care unit (ICU) (**Anusha, and Radhika, 2022**). In the ICU, there are four different types of stress: physical, mental, communicative, or environmental, according to a study by (**Krampe et al., 2021**). The last type, the environment, is unaffected by these factors, whereas the first three types are determined by the patient, the diagnosis, and the course of treatment. Particularly, exposure to multiple stimuli in the ICU, such as sounds, lights, and temperatures, has a negative effect on critically ill patients (**Gultekin et al., 2018; Krampe et al., 2021**).

On the one hand, the sound of alarms and nearby activity may overwhelm critically ill patients (**Tronstad et al., 2021**). The hospital's environmental and architectural factors have a significant impact on patients' sensory environment and whether they are at risk of receiving too much or too little stimulation (Tronstad et **al., 2021; Verderber et al., 2021**). The risk of sensory overload or deprivation is further increased by other patient treatment considerations, such as intubation, because the patient is unable to express their needs (**Krampe et al., 2021**). Critical care nurses and other

healthcare team, including occupational therapists, have started using specific forms of visual and auditory stimuli in clinical practice to address the lack of stimulation and improve the orientation of existing stimuli (**Jawed et al., 2021; Aileen et al, 2022**).

Several studies on unconscious patients have documented that they can hear and perceive sounds, and that sensory stimulation of any kind can stimulate the brain cortex and the reticular activating system. Even unconscious patients respond effectively, a decrease of structured verbal communication with these patients could aggravate their status and prolong the improvement of consciousness. Sensory stimulation programmes for comatose patients may help the patients quickly resume their consciousness by stimulating their level of consciousness, attention, and concentration with the proper intensity and manner (**Ribeiro et al., 2014; Aileen et al, 2022; Patel et al., 2020).**

Auditory stimulation is required because hearing is the last sensation that unconscious patients retain. The nursing staff and other members of the healthcare team therefore use verbal communication as auditory stimulation with the patient as part of their everyday health care activities. To help comatose patients recover, the healthcare team must ensure that they receive the appropriate environmental stimulation. Auditory stimulation for unconscious patients can be carried out using a variety of voices with various effects, such as a familiar voice that the patient may more readily remember. Strong and repeated auditory stimulation may help in a patient's recover from a coma and resume a higher level of functioning (**Varghese et al., 2020**).

According to evidence-based practices, hearing a mother's voice assists in activating certain parts of the brain that other sounds do not. Mother's voice has a greater effect on patients' behavioral and neurological responses and increases frontal brain activity, especially in children **(Song et al., 2017).** The most calming and familiar voice in a child's life is the mother's voice, which is heard frequently (even before birth). Mothers spend the most time with their kids and frequently use sentences to comfort and care for them **(Shogi et al., 2021).**

**Significance of the study:**

The recurrent cause of admission to pediatric intensive care units is coma. Children who are not properly cared for may experience long-term disabilities, which would put a financial strain on families and communities and lead to a lower standard of living. Those who are comatose run a greater risk of sensory deprivation (**Mejiozem et al., 2022).**

Since hearing is the final sense that comatose patients lose, auditory stimulation is crucial. Critical care nurses should ensure that adequate environmental stimuli are provided for the recovery of comatose patients. Different voices with varied effects, such as the patient's mother's voice, which they can more easily recall, can be used for auditory stimulation **(Mohammadi et al., 2017; Wu et al., 2018).** According to Statistics of pediatric Intensive Care Unit at Assiut University Children's Hospital, Egypt in the years of (2021) revealed that the number of unconscious patients admitted were 630 (**Hospital records of Assuit Children's Hospital 2021**).

**Aim of the study:**

This study aimed to examine the effect of mother voice on physiological parameters and level of consciousness of patients in pediatric intensive care unit. Dependent variable was mother voice while independent variables were physiological parameters (heart rate, blood pressure, respiration, oxygen saturation) and level of conscious.

**Research hypothesis:**

- The level of consciousness of patients in the interventional group would be significantly higher than that in the control group.
- The physiological parameters (heart rate, systolic blood pressure, diastolic blood

pressure, and oxygen saturation) of patients in the interventional group would be significantly improved compared to the control group.

**Operational definitions:**

- **Mother Voice:** It is listening to recorded child mother voice with a normal conversational voice with no change or editing to the mother's voice.
- **The physiological parameters**: involving blood pressure, heart rate, respiratory rate, GCS, and oxygen saturation of the arterial blood.

**Research design and setting:**

A quiz experimental study was carried out from beginning of March 2022 till end of October 2022 in pediatric Intensive Care Unit (14 beds separated over 14 sectors and the staff nurse this unit are 3 head nurse, 23 nurse and 4 assistance nurse ) at Assiut University Children's Hospital, Egypt.

**Sample:**

Purposive sampling of sixty patients admitted to the previously mentioned settings. Patients were randomly assigned in to two equal groups (control and intervention groups) considering the following matching criteria; age group of 5 years, sex, and comorbidity. The sample size was calculated based on the Epi info program according to the total population admitted per year to the pediatric intensive care unit, and it was calculated as the following:

Z= confidence level 95%, d= Error proportion (0.05), P= population (80%), assuming total numbers of patient's admission.

**Inclusion criteria:** The study involved those who met the following inclusion criteria: Patients were between the ages of 1 and 18 years, patients did not have hearing disorders, and with Glasgow Coma Scale (GCS) on admission of greater than 3.

**Tools:** The researchers used two tools to collect the data in the current study**:**

**Tool one: Physiological parameters assessment sheet:** The researchers developed this tool to collect the data in the current study based on reviewing of the relevant literatures **(Green, 2011; Shogi, et al., 2021).** This tool divided to two parts: **Part one: Personal and clinical data** involving patient's code, gender, age, patient's diagnosis, and past medical history which was used to evaluate patient base line data and it was recorded from patient profile. **Part two: Physiological parameters** include heart rate (HR), respiratory rate (RR), blood pressure (BP), and peripheral oxygen saturation (SpO2).

**Tool two: Glasgow Coma Scale:** A conscious state was assessed utilizing Glasgow Coma Scale, that developed by **Green 2011** is a neurological scale aims to give a reliable, objective way of recording the conscious state of a person for initial as well as subsequent assessment. The scale comprises three tests: Best eye response (E) there are 4 grades starting with the most severe, best verbal response (V) there are 5 grades starting with the most severe, and best motor response (M) there are 6 grades starting with the most severe responses. In the GCS, each of the component scores as well as the sum of the components is considered. The total score is out of 15-points, with lower scores indicating more severe impairment. The lowest possible GCS total score is 3, indicating deep coma or death, and the highest possible score is 15, indicating a fully awake individual. The Scoring system for GCS is.

- Severe= GCS ≤ 8
- Moderate= GCS 9 - 12
- Mild = GCS ≥ 13.

**Methods**

The current study was conducted throughout three main phases, which included preparatory, implementation, and evaluation phases. The preparatory phase took about two months, while the

implementation and evaluation phases took about eight months.

- **Preparatory phase:**

- **Tools development:** The researchers developed the study tool depend on a review of the relevant literature.

- **Ethical consideration**:

  - **An approval** from the Scientific Research Ethical Committee of the Faculty of Nursing Assiut University was obtained to conduct the study and delivered to the director of the pediatric intensive care unit affiliated to Assiut University Children's Hospital through official letters after explaining the aim of the study before data collection.

  - Written consent was obtained from patient's care giver (mother &father) that are willing to participate in the study, after explaining the nature and purpose of the study. Confidentiality and anonymity were assured to all studied patient's care giver. Study participants were given the assurance that they had the freedom to refuse to participate and/or to leave the study at any moment without explanation. When gathering data, study subject privacy was taken into account.

- **Content validity:** The study tool was evaluated for content validity by a jury of five specialists in the fields of critical care nursing and pediatric nursing from the Faculty of Nursing at Assiut University. The validity index was 0.87, and no modifications were reported.

- **Reliability** of the study tool was assessed using Cronbach's Alpha test, which turned out to be 0.969 to assess the consistency and stability of the tools.

- **A Pilot study:** A pilot study was performed before the beginning of data collection on 10% of the sample size who were admitted to the pediatric intensive care unit in Assuit University Children's Hospital to assess the applicability, clarity of the tools. According to this pilot study, no necessary modifications were made.

- **Implementation phase:**

- The researchers assessed the personal and clinical data of patients in both study and control groups (age, gender, diagnosis, etc.) to provide a baseline date about each patient, which was taken from the patients' profiles.

- For the control group, they were exposed to the usual voices within the pediatric intensive care unit as well as the sounds of the health care team.

- For the intervention group, they were exposed to the recorded maternal voice.

**Voice message recording technique:**

- Each patient's mother was personally interviewed, and she was given written and verbal instructions on how to record the message with a similar and understandable accent to the patient's. The voice message was then recorded by the voice recording device in the presence of the researcher and in the pediatric ICU's visiting room prior to the start of the intervention. The mother's voice message was recorded for a maximum of 10 minutes; she spoke for 5-minutes and sang for 5-minutes.

- The mother's voice message was recorded in a normal conversational voice with no change or editing to the mother's voice. Each massage included 5 minutes in which the mother talked about any special event or any special moment that they had spent together and reported something about their family life. And for the other 5 minutes, the mother was singing the child's favorite song. Each message differs from one child to another. Each child takes 20 minutes to listen to the massage twice in each session. The intervention group's patients underwent hearing stimulation using an MP3 player and headphones for three days in a row, two sessions per day, after the researcher had prepared the voice message and controlled its content. Each session lasted 20 minutes and helped to shield the patients from background noise in the ICU other than the researcher's prepared maternal voice stimulus.

- Prior to the intervention session, it was ensured that the patients were lying in a posture that would allow the researcher to monitor and assess the physiological parameters; they were also attached to the physiological monitoring system. The physiological parameters involving blood pressure, heart rate, respiratory rate, GCS, and oxygen saturation of the arterial blood were recorded after hearing maternal voice stimulation sessions and recording the readings.
- **Evaluation phase:** During the evaluation phase of the study, both the control and the intervention groups were assessed two times each day for three consecutive days to examine the effect of maternal voice on physiological parameters (heart rate, blood pressure, respiration, oxygen saturation, level of consciousness) of patients on the pediatric intensive care unit.

**Statistical analysis:**

The statistical package for the social science (SPSS) version 26 was used for data entry and analysis. Numbers, percentage means, and standard deviation were used to present the data. Chi-square test was used to show relation between variables. T-test was used to compare mean. P-value considered statistically significant when $p < 0.05$.

## Results

**Table 1** shows that (53.3%, 76.7%) of the participant patients were female in the control and intervention groups, respectively, with an average age of (6.43±4.89) years in the control group and (5.04±3.01) years in the intervention group. (56.7 %) of the control group versus (53.3 %) of the intervention were diagnosed with respiratory diseases.

**Table 2** illustrates that there was statistical significant difference between the control and the intervention groups as regard oxygen saturation in 2nd session in the 3rd day of admission (p= 0.020).

**Table 3** reveals that there is no statistical significant difference among the control and the intervention groups as regard systolic blood pressure and diastolic blood pressure from the 1st to the 3rd day.

**Table 4** shows that the level of consciousness of the intervention group improved throughout three consecutive days of the study with no statistical significant difference during the first and second day, while statistically significant difference was noticed in the 1st and 2nd sessions on the third day of the intervention between the control and the intervention group (p= 0.020).

**Table (1):** Distribution of personal and clinical characteristics of control and intervention groups (total N=60).

| Variables | Control group (n=30) | | Intervention group (n=30) | |
|---|---|---|---|---|
| | **No** | **%** | **No** | **%** |
| **Gender** | | | | |
| Male | 14 | 46.7 | 7 | 23.3 |
| Female | 16 | **53.3** | 23 | **76.7** |
| **Age category (years)** | | | | |
| 1-5 years | 17 | 56.7 | 20 | 66.7 |
| 5-10 years | 6 | 20.0 | 9 | 30.0 |
| 10-18 years | 7 | 23.3 | 1 | 3.3 |
| **Mean±SD** | **6.43±4.89** | | **5.04±3.01** | |
| **Diagnosis** | | | | |
| Respiratory diseases | 17 | **56.7** | 16 | **53.3** |
| Cardiac diseases | 1 | 3.3 | 2 | 6.7 |
| GIT diseases | 5 | 16.7 | 11 | 36.7 |
| Neurological diseases | 15 | 50.0 | 8 | 26.7 |

- Chi square test for qualitative data between the two groups
- Mann Whitney test for non-parametric quantitative data between the two groups

*Significant level at P value < 0.05, **Significant level at P value < 0.01

Note: some patients have more than one diagnosis.

**Table (2):** Distribution of heart rate, respiration and oxygen saturation among of control and intervention groups (N=60).

| Variables | Control group (n=30) Mean±SD | Intervention group (n=30) Mean±SD | P.value |
|---|---|---|---|
| **Heart rate** | | | |
| **1st day** | | | |
| ▪ 1st Session | 132.4±22.94 | 130.03±25.85 | 0.709 |
| ▪ 2nd Session | 131.67±27.1 | 131.13±22.92 | 0.935 |
| **2nd day** | | | |
| ▪ 1st Session | 122.27±27.99 | 130.23±24.22 | 0.243 |
| ▪ 2nd Session | 124.83±28.19 | 130.6±24.6 | 0.402 |
| **3rd day** | | | |
| ▪ 1st Session | 125.67±27.77 | 132.33±19.9 | 0.290 |
| ▪ 2nd Session | 125.03±28.54 | 136.3±22.41 | 0.094 |
| **Respiration** | | | |
| **1st day** | | | |
| ▪ 1st Session | 31.8±11.73 | 35.43±14.29 | 0.286 |
| ▪ 2nd Session | 34.67±12.44 | 33.53±13.74 | 0.739 |
| **2nd day** | | | |
| ▪ 1st Session | 30.3±11.91 | 35.97±14.67 | 0.106 |
| ▪ 2nd Session | 34.73±16.01 | 34.13±13.26 | 0.875 |
| **3rd day** | | | |
| ▪ 1st Session | 34.23±14.82 | 38.13±10.4 | 0.243 |
| ▪ 2nd Session | 31.17±14.61 | 36.07±9.58 | 0.130 |
| **Spo2** | | | |
| **1st day** | | | |
| ▪ 1st Session | 97.1±5.75 | 96.97±2.25 | 0.906 |
| ▪ 2nd Session | 96.6±4.41 | 96.83±1.84 | 0.790 |
| **2nd day** | | | |
| ▪ 1st Session | 94.9±9.1 | 96.87±3.13 | 0.194 |
| ▪ 2nd Session | 94.47±12.78 | 96.4±3.16 | 0.424 |
| **3rd day** | | | |
| ▪ 1st Session | 92.6±10.79 | 96.33±3.63 | 0.078 |
| ▪ 2nd Session | 92.77±9.8 | 97.17±2.57 | **0.020*** |

- SpO2: peripheral capillary oxygen saturation - Independent T-test quantitative data between the two groups

*Significant level at P value < 0.05

**Table (3):** Distribution of systolic blood pressure and diastolic blood pressure among of control and intervention groups (N=60).

| Variables | Control group (n=30) Mean±SD | Intervention group (n=30) Mean±SD | P.value |
|---|---|---|---|
| **SBP** | | | |
| **1st day** | | | |
| ▪ 1st Session | 106.33±16.86 | 105.33±11.67 | 0.790 |
| ▪ 2nd Session | 111.27±15.84 | 104±15.89 | 0.081 |
| **2nd day** | | | |
| ▪ 1st Session | 109.67±19.03 | 109±12.42 | 0.873 |
| ▪ 2nd Session | 107.97±17.82 | 106.67±14.46 | 0.757 |
| **3rd day** | | | |
| ▪ 1st Session | 102.33±19.24 | 105±17.57 | 0.577 |
| ▪ 2nd Session | 98.7±21.63 | 104±14.99 | 0.275 |
| **DBP** | | | |
| **1st day** | | | |
| ▪ 1st Session | 61.33±19.61 | 57.67±8.98 | 0.356 |
| ▪ 2nd Session | 64±16.73 | 56±14.04 | 0.050 |
| **2nd day** | | | |
| ▪ 1st Session | 66.33±15.86 | 62.67±13.88 | 0.345 |
| ▪ 2nd Session | 65.67±14.78 | 61.33±12.79 | 0.230 |
| **3rd day** | | | |
| ▪ 1st Session | 59.67±17.71 | 58.67±13.83 | 0.808 |
| ▪ 2nd Session | 55.33±18.52 | 58±14.72 | 0.539 |

- SBP: Systolic blood pressure - DBP: diastolic blood pressure
- Independent T-test quantitative data between the two groups

*Significant level at P value < 0.05

**Table (4):** Comparison between the control and the intervention groups in relation to level of conscious assessment using Glasgow coma score (n=60)

| GCS | Control group (n=30) | Intervention group (n=30) | P.value |
|---|---|---|---|
| | Mean±SD | Mean±SD | |
| **1st day** | | | |
| ▪ 1st Session | 5.07±2.49 | 5.47±2.57 | 0.543 |
| ▪ 2nd Session | 5.07±2.49 | 5.4±2.51 | 0.608 |
| **2nd day** | | | |
| ▪ 1st Session | 4.9±2.44 | 5.77±3.2 | 0.080 |
| ▪ 2nd Session | 4.97±2.47 | 5.77±3.2 | 0.086 |
| **3rd day** | | | |
| ▪ 1st Session | 4.1±2.09 | 6.1±2.76 | **0.020*** |
| ▪ 2nd Session | 4.1±2.09 | 6.17±2.84 | **0.020*** |

- Independent T-test quantitative data between the two groups

*Significant level at P value < 0.05

## Discussion:

Several non-pharmaceutical measures, such as muscular relaxation, mental imagery, and focus are not feasible due to the critical conditions of patients in ICUs. It believes that listening to the mother's recorded voice is a simple and viable solution when the mother is absent. On the other hand, there was little knowledge regarding the efficacy of this approach in childhood. The majority of studies concentrate on the effect of a mother's voice stimuli on pain. Therefore, this study aimed to examine the effect of mother's voice on physiological parameters and the level of consciousness of patients in the pediatric intensive care unit.

As regards personal characteristics, the current study found that there was no significant difference between the both study groups in terms of age, and more than half of the patients in both groups were female. This result is consistent with **(Varghese et al., 2020)** who reported that the characteristics of the study participants were homogenous and the p values were greater than 0.05, which indicated that there were no significant differences between the study group and the control group in terms of these variables.

**Regarding comparing the effect of mother-voice stimuli on the physiological parameters among patients in the intervention group,** the current study results show no statistically significant difference in terms of heart rate, respiratory rate, SBP, and DBP in the first and second sessions over the three consecutive days of the study period. While a statistically significant improvement in oxygen saturation (Spo2) was observed in the intervention group on the third day of the first or second session of the intervention.

**From the researcher's point of view,** the current results may relate to the different age groups, as the study included all the childhood age categories. There were also a small number of days for applying the intervention; as such intervention need more time to cause an effect such as a lot of non-pharmacological interventions.

These results are supported by (**Varghese et al., 2020**) who stated that there was no statistically significant difference in systolic blood pressure and diastolic blood pressure between the study and control groups. Also, following the intervention, there was no clinically significant difference in the heart rate between the two groups of comatose patients. Another study by (**Walker et al., 2018**) showed no statistically significant differences in the mean values of heart rate, systolic and diastolic blood pressure, and oxygen saturation before, during, and after the intervention.

This current finding is supported by (**Khojeh et al., 2018**) who documented that there was no statistically significant difference between physiological parameters such as blood pressure and temperature before and after intervention. Nevertheless,

(**Khojeh et al., 2018**) disagreed with the current findings and found that there was no statistically significant difference between the arterial blood's oxygen saturation before and after intervention in their study.

In contrast to all the studies mentioned above and the current study (**Anusha and Radhika, 2022)** reported that there was a statistically significant difference between the pretest and post-test mean for the studied patients' heart and respiratory rates in the intervention group. While the heart rate and respiratory rate in the control group did not significantly improve between the pre-test and post-test.

**In terms of the effect of mother voice stimuli on the level of consciousness,** the results of the current study demonstrate that the level of consciousness of the intervention group improved throughout three consecutive days of the study with no statistically significant difference during the first and second days, while a statistically significant difference was noticed in the 1st and 2nd sessions on the third day of the intervention between the both study groups. This can be interpreted from the point of view of the researcher by saying that the recorded mother's voice has a significant effect on resuming the level of consciousness of comatose patients when it is applied for a period of time and with repetition of the technique, which gives the patient a feeling of security and safety that his mother is always present with him, even during his presence in the hospital and while waiting for his recovery.

The current results are consistent with **(Davis et al., 2014)** which showed that auditory sensory stimulation increased the daily mean of GCS scores in the study group compared to the control group. Also, these results are consistent with (**Mohammadi et al., 2019)** illustrated that a significant rise in the intervention group's posttest mean level of consciousness scores throughout the course of the three evaluations ($P < .001$). Although no significant difference was detected in the control group with regard to the changes in the posttest means scores of consciousness over time.

The study conducted by **(Çevik and Namik, 2018)** also revealed that mean GCS on the first day of the study following auditory stimulation was 4.8 in the study group and 4.7 in the control group. The mean GCS of patients in the study group was 9.5 and 7.1 for patients in the control group in the morning, while the mean GCS was 9.6 and 7.2, respectively, in the evening before and after the auditory stimulation on the tenth day. On the first three days, there were no statistically significant differences in the mean GCS ($P >.05$). The difference in mean GCS scores between the two groups became statistically significant after the third day (P.05), which contradicts the findings of the present study.

The application of regular auditory and tactile stimulation by trained family members has very statistically significant favorable impacts. Patients in the study group had higher levels of consciousness, fewer physiological adverse events occurred, and spent less time in the intensive care unit (**Ahmed, 2023**).

## Limitation of the study:

The study was carried out on a small sample size in one hospital. All children admitted to the pediatric ICU were included in the study, regardless of their age group or GCS score on admission, which may have an effect on the results.

## Conclusion:

In the light of current study results, it can be summarized that auditory stimulation utilizing the mother's voice has a significant effect on improving the level of consciousness and oxygen saturation in comatose pediatrics patients.

## Recommendations:

Replication of other studies on a larger sample size in different settings within a different age population utilizing multimodal stimulation (auditory, visual, and tactile

stimulation) can be used either independently or in combination to examine its effect on several additional factors such as mechanical ventilation and length of stay.

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