

Case Study: Nursing Care for a Post-Craniotomy Patient with an Endotracheal Tube (ETT) for the Nursing Diagnosis of Ventilator Weaning Difficulty, Including Chest Physical Therapy and Deep Suction in the ICU at Cempaka Putih Islamic Hospital

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ABSTRACT

Background & Objective: Patients after craniotomy often require mechanical ventilation through the insertion of an endotracheal tube (ETT). This condition carries the risk of ventilator weaning disorders due to secretions buildup, decreased cough reflex, and respiratory muscle weakness. To implement nursing interventions in the form of chest physiotherapy and deep suction in an effort to maintain airway patency and support successful ventilator weaning. **Method:** Describing nursing care for patients with ventilator weaning disorders through chest physiotherapy and deep suction interventions. This case study uses a descriptive case study with a nursing care approach to post craniotomy patients who use endotracheal tubes (ETT) and experience problems in the ventilator weaning process in the ICU of Cempaka Putih Islamic Hospital. The method used in this study is a combination of chest physiotherapy and deep suction twice a day for 3 consecutive days. The desired outcome of the intervention was weaning from the ventilator and additional criteria, namely ventilator assistance synchronization, use of accessory breathing muscles, shallow breathing, respiratory rate, breathing effort, SpO₂, rales, sputum production, and RR. **Results:** After intervention, oxygen saturation increased from 96% to 100% and was maintained, sputum production decreased from 410 cc to 100 cc, and rales disappeared. CRT parameters also showed improvement from 4 seconds to 2 seconds. **Conclusion:** The combination of chest

physiotherapy and deep suction interventions was effective in increasing oxygen saturation, reducing secretion production, and improving respiratory parameters in post-craniotomy patients with ventilator weaning disorders.

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Introduction

Craniotomy is a surgical procedure performed by opening or removing part of the skull bone to gain access to the intracranial space. Craniotomy aims to stop active bleeding, remove damaged brain tissue or blood clots, and reduce intracranial pressure to prevent more serious complications (Rosyida & Arofiati, 2025). This procedure is generally performed in life-threatening neurological conditions, such as hemorrhagic stroke, brain tumors, and severe head injuries. Craniotomy is widely needed in life-threatening cases, which is in line with the high incidence of neurological diseases and injuries worldwide.

Based on the Global Burden of Disease (GBD) report in 2018, the incidence of hemorrhagic stroke is estimated at 10–15 per 100,000 population per year and accounts for about 20–30% of all stroke cases. One of the most common forms of hemorrhagic stroke is intracerebral hemorrhage (ICH), with a global case count of 28.8% (Feigin et al., 2025). In addition, the global incidence of brain tumors has been reported to reach 10.82 per 100,000 population per year, with the most commonly found type of brain tumor being glioma, accounting for 78% of all cases (Pratama et al., 2024). Head injury is also a major health problem that often requires surgical intervention, with 500,000 cases per year in the United States, of which 20.4% are severe head injuries (Agustiani, 2024).

Meanwhile, in Indonesia, data from the Basic Health Research (Ministry of Health of the Republic of Indonesia, 2018) show that the prevalence of stroke is in the range of 10–15 per 1,000 population, with hemorrhagic stroke accounting for about 20–30% of all stroke cases. Intracerebral hemorrhage as one form of hemorrhagic stroke is reported to range from 8–13% of total stroke cases in Indonesia. Meanwhile, the incidence of brain tumors in Indonesia is estimated to reach 8–10 per 100,000 population per year (Alam et al., 2025). Head injury is also a significant health problem, with an incidence rate recorded at 11.9% based on data (Ministry of Health of the Republic of Indonesia, 2018), so in certain conditions it requires surgical treatment such as craniotomy.

Post-craniotomy patients generally require mechanical ventilation assistance through the installation of an endotracheal tube (ETT). The use of an ETT can risk reducing the cough reflex and will cause secretion accumulation, thereby increasing the risk of ventilator weaning disorders and can cause lower respiratory tract infections such as ventilator-associated pneumonia (VAP) (Yunus et al., 2025). Therefore, the nurse's role becomes important in maintaining airway patency through appropriate interventions. One nursing effort that can be done to prevent ventilator weaning disorders is to maintain airway patency through the provision of chest physiotherapy and deep suction procedures. This nursing intervention aims to help

secretion removal, improve ventilation, and support the success of the weaning process.

One of the interventions carried out in patients with ventilator weaning disorders is deep suction. Deep suction is a secretion suction procedure performed by passing beyond the tip of the endotracheal tube. Deep suction is performed using the catheter suction method, in which the catheter is pushed inward until resistance is met and then the catheter is pulled back 1 cm before suctioning is carried out with negative pressure (Noho R et al., 2023). The evaluation of the suction procedure is increased breath sounds, increased arterial blood gas values or oxygen saturation, and disappearance of pulmonary secretions (Apui et al., 2023).

In addition, to further improve secretion removal in patients with ventilator weaning disorders, chest physiotherapy intervention can be added. Chest physiotherapy intervention is a procedure involving tapping the areas where secretions have accumulated. Chest physiotherapy aims to remove secretions so that oxygen saturation can increase. Chest physiotherapy is carried out with a combination consisting of postural drainage, clapping, and vibration for 5–10 minutes per session. This chest physiotherapy can be done twice a day in the morning and evening, for 3 days to obtain effective results in secretion removal and increased saturation.

Objective

The purpose of this study is to comprehensively describe the nursing care process for post-craniotomy patients with an endotracheal tube (ETT) who have been diagnosed with ventilator weaning difficulties, including the administration of chest physical therapy and deep suctioning in the ICU at Cempaka Putih Islamic Hospital.

Method

This study used a descriptive case study design with a nursing care approach on a single post-craniotomy patient using an endotracheal tube (ETT) who experienced difficulties in the ventilator weaning process in the ICU. The inclusion criteria were post-craniotomy patients undergoing treatment in the ICU with an endotracheal tube (ETT) and mechanical ventilator, experiencing ventilator weaning difficulties, having secretion accumulation in the airway indicated by additional breath sounds such as ronchi, and being in a stable hemodynamic condition. The exclusion criteria were patients with unstable hemodynamic conditions, uncontrolled increased intracranial pressure, rib fractures, risk of recurrent bleeding, and severe hypoxia. The instruments used included nursing care sheets, observation sheets, patient monitors, stethoscopes, pulse oximeters, suction machines with their tubing, and medical records.

The research procedure began with a preparation stage involving research permit processing and selecting subjects according to predetermined criteria, followed by an initial assessment through alloanamnesis interviews with the family and direct observation by monitoring vital signs and respiratory parameters including oxygen saturation (SpO₂), respiratory rate, ventilator synchrony, use of accessory respiratory muscles, ronchi, sputum production, and capillary refill time (CRT), as well as systematic physical examination and documentation during the care period. The next stage was performing nursing interventions in the form of chest physiotherapy and deep suction according to standard operating procedures (SOP); chest physiotherapy was performed to remove secretions through a series of nursing actions including

positioning the patient in a lateral position, performing percussion (clapping), and performing vibration, carried out for 2–5 minutes for each action, followed by deep suction performed by inserting the suction catheter into the endotracheal tube (ETT) until it exceeded the tip of the ETT by about 1–2 cm (in adults, the ETT is generally at a depth of ± 19 cm to the carina), with the suction process lasting no more than 15 seconds. The final stage was systematically documenting the results in the observation sheet and observing the patient's condition before and after the intervention.

Result

A 60-year-old woman, known as Mrs. S, was brought to the hospital by her family with the primary complaints of decreased consciousness and weakness in her left arm and leg. During her stay in the ICU, the patient was in a comatose state, on a ventilator, had high blood pressure, abnormal breathing, and decreased oxygen saturation. The patient's family reported that she had a 6-year history of uncontrolled hypertension. They stated that she had no allergies and that this was her first time being hospitalized.

A physical examination was conducted to measure vital signs and assess the respiratory system. The findings were as follows: blood pressure 158/57 mmHg, pulse 99 beats per minute, temperature 36.70°C, respiratory rate 32 breaths per minute, and SpO₂ 96%. Respiratory assessment revealed the use of accessory breathing muscles and the presence of rales (+). Laboratory results showed a hemoglobin level of 11.4 g/dL, white blood cell count of $15.33 \times 10^3/\mu\text{L}$, blood urea of 63 mg/dL, blood creatinine of 1.6 mg/dL, and blood glucose of 296 mg/dL. Arterial blood gas analysis results indicated a pH of 7.37, PCO₂ 32.2 mmHg, and HCO₃ 18.9 mmol/L, interpreted as compensated metabolic acidosis. Additionally, a head CT scan was performed, revealing right peritoxipital intraparenchymal hemorrhage and hydrocephalus with bilateral lateral ventricular hemorrhage in the third and fourth ventricles.

Observations of Mrs. S's respiratory parameters over three consecutive days (January 15–17, 2026) showed a gradual improvement in her respiratory condition following chest physical therapy and deep suction interventions. The parameters observed included Positive End-Expiratory Pressure (PEEP), use of accessory breathing muscles, breathing pattern, respiratory rate, respiratory effort, sputum production, additional breath sounds (rales), oxygen saturation (SpO₂), and Capillary Refill Time (CRT).

TABLE 1. Results of PEEP Observations in Mrs. S

Examination Date	Time	Observation Results	
		Before	After
15-01-2026	08.00	6	6
	15.00	6	6
16-01-2026	08.00	5	5
	15.00	5	5
17-01-2026	08.00	4	4
	15.00	4	4

Monitoring of PEEP levels showed a gradual decrease over the course of observation. On the first day, the PEEP level was 6 cmH₂O; it then decreased to 5 cmH₂O on the second day and further decreased to 4 cmH₂O on the third day. This

decrease indicates an improvement in pulmonary ventilation and an increase in the patient's tolerance to the ventilator weaning process.

TABLE 2. Results of Respiratory Rate Observations for Mrs. S

Inspection Date	Time	Observation Results	
		Before	After
15-01-2026	08:00	32x/min	32x/min
	15:00	32x/min	23x/min
16-01-2026	08:00	23x/min	17x/min
	15:00	17x/min	15x/min
17-01-2026	08:00	15x/min	14x/min
	15:00	14x/min	12x/min

The patient's respiratory rate showed a significant decrease during the observation period. At the start of the assessment, the respiratory rate was recorded at 32 breaths per minute, then gradually decreased to 23 breaths per minute on the first day during the afternoon session. On the second day, the respiratory rate decreased further to 17 breaths per minute and then to 15 breaths per minute, reaching 12 breaths per minute on the third day. This decrease indicates an improvement in respiratory efficiency and a reduction in the work of breathing.

TABLE 3. Results of Observations on the Use of Accessory Breathing Muscles in Mrs. S

Inspection Date	Time	Observation Results	
		Before	After
15-01-2026	08:00	Presence of accessory respiratory muscles	Presence of accessory respiratory muscles
	15:00	No visible use of accessory respiratory muscles	No visible use of accessory respiratory muscles
16-01-2026	08:00	No visible use of accessory respiratory muscles	No visible use of accessory respiratory muscles
	15:00	No visible use of accessory respiratory muscles	No visible use of accessory respiratory muscles
17-01-2026	08:00	No visible use of accessory respiratory muscles	No visible use of accessory respiratory muscles
	15:00	No visible use of accessory respiratory muscles	No visible use of accessory respiratory muscles

Observation of the use of accessory respiratory muscles showed that during the initial examination on January 15, 2026, at 8:00 a.m., the use of accessory respiratory muscles was still evident; however, during the subsequent examination on the same day, no use of accessory respiratory muscles was observed. This condition remained stable through the second and third days of observation, indicating that the patient's respiratory effort was gradually improving.

TABLE 4. Results of the CRT Observation for Mrs. S

Inspection Date	Time	Before	After
15-01-2026	08:00	CRT 4 seconds	CRT 4 seconds
	15:00	CRT 4 seconds	CRT 4 seconds
16-01-2026	08:00	CRT 3 seconds	CRT 3 seconds
	15:00	CRT 3 seconds	CRT 3 seconds
17-01-2026	08:00	CRT 2 seconds	CRT 2 seconds
	15:00	CRT 2 seconds	CRT 2 seconds

Improvements in peripheral circulation were also evident in the Capillary Refill Time (CRT) values. On the first day, the CRT was recorded at 4 seconds; it then decreased to 3 seconds on the second day and reached 2 seconds on the third day. These values indicate an improvement in peripheral perfusion.

TABLE 5. Results of the Observation of Shallow Breathing in Mrs. S

Inspection Date	Time	Before	After
15-01-2026	08:00	Shallow breathing observed	Shallow breathing observed
	15:00	No shallow breathing observed	No shallow breathing observed
16-01-2026	08:00	No shallow breathing observed	No shallow breathing observed
	15:00	No shallow breathing observed	No shallow breathing observed
17-01-2026	08:00	No shallow breathing observed	No shallow breathing observed
	15:00	No shallow breathing observed	No shallow breathing observed

Similar changes were also observed in the patient's breathing pattern. At the start of the observation period, shallow breathing was still present; however, following the intervention on the first day during the afternoon session, shallow breathing was no longer observed. This condition remained consistent through the second and third days, indicating an improvement in the patient's ventilation pattern.

TABLE 6. Results of Observation of Mrs. S's Breathing Efforts

Inspection Date	Time	Before	After
15-01-2026	08:00	Spontaneous breathing effort observed	Spontaneous breathing effort not yet observed
	15:00	Spontaneous breathing effort observed	Spontaneous breathing effort not yet observed
16-01-2026	08:00	Spontaneous breathing effort observed	Spontaneous breathing effort observed
	15:00	Spontaneous breathing effort observed	Spontaneous breathing effort observed
17-01-2026	08:00	Spontaneous breathing effort observed	Spontaneous breathing effort observed
	15:00	Spontaneous breathing effort observed	Spontaneous breathing effort observed

Observations of the patient's breathing efforts showed that on the first day, no spontaneous breathing efforts were observed following the procedure. However, from the second to the third day, spontaneous breathing efforts began to appear and remained stable until the end of the observation period. This indicates a gradual improvement in the patient's respiratory function.

TABLE 7. Results of the Observation of Rochi's Voice in Mrs. S

Inspection Date	Time	Before	After
15-01-2026	08:00	Ronchi present	Ronchi present
	15:00	Ronchi present	Ronchi present
16-01-2026	08:00	No ronchi present	No ronchi present
	15:00	No ronchi present	No ronchi present
17-01-2026	08:00	No ronchi present	No ronchi present
	15:00	No ronchi present	No ronchi present

Pulmonary auscultation revealed the presence of rales on the first day of observation, both before and after the intervention. However, on the second and third

days, no rales were detected. The disappearance of these additional breath sounds indicates that secretions in the airways have decreased significantly.

TABLE 8. Results of Observations on Sputum Production and Oxygen Saturation in Mrs. S

Observation Results			
Inspection Date	Time	Before	After
15-01-2026	08:00	0	Secretion 220 cc
	15:00	Secretion 220 cc	Secretion 190 cc
16-01-2026	08:00	Secretion 190 cc	Secretion 110 cc
	15:00	Secretion 110 cc	Secretion 90 cc
17-01-2026	08:00	Secretion 90 cc	Secretion 70 cc
	15:00	Secretion 70 cc	Secretion 30 cc
Oxygen Saturation Observation Results			
Inspection Date	Time	Before	After
15-01-2026	08:00	SpO ₂ 96%	SpO ₂ 98%
	15:00	SpO ₂ 99%	SpO ₂ 100%
16-01-2026	08:00	SpO ₂ 97%	SpO ₂ 99%
	15:00	SpO ₂ 99%	SpO ₂ 100%
17-01-2026	08:00	SpO ₂ 98%	SpO ₂ 100%
	15:00	SpO ₂ 99%	SpO ₂ 100%

Sputum production also showed a fairly clear decrease during the intervention period. On the first day after the procedure, 220 cc of secretions were collected, which then decreased to 190 cc in the next session. On the second day, sputum production decreased to 110 cc and 90 cc, while on the third day it decreased further to 70 cc and finally reached 30 cc in the last session. This decrease in sputum production indicates that chest physiotherapy and deep suction are effective in helping to mobilize and remove secretions from the airways. Additionally, oxygen saturation monitoring results showed an increase during the intervention period. At the start of the observation, oxygen saturation was in the 96% range, then increased to 98–100% after the procedures were performed. On the second and third days, the patient's oxygen saturation remained stable in the 99–100% range. This indicates that the interventions administered were effective in improving the patient's oxygenation.

Overall, the evaluation results show that the routine administration of chest physiotherapy and deep suction interventions over three days had a positive impact on improving the patient's respiratory function. This was marked by a decrease in PEEP values, a decrease in respiratory rate, reduced sputum production, the disappearance of rales, increased oxygen saturation, and improved peripheral perfusion. These findings indicate that these interventions are effective in helping to maintain airway patency and support the ventilator weaning process in post-craniotomy patients with endotracheal tubes.

Discussion

Assessment

Assessment is the initial stage of the nursing process, which aims to comprehensively identify the patient's clinical condition as the basis for establishing nursing diagnoses and planning appropriate interventions. The assessment of Mrs. S, a post-craniotomy patient with an endotracheal tube (ETT), revealed respiratory impairment characterized by an increased respiratory rate of 32 breaths/minute, the

use of accessory respiratory muscles, shallow breathing, considerable sputum production, and the presence of additional breath sounds, specifically rhonchi, on pulmonary auscultation.

In addition, the patient remained dependent on mechanical ventilation, with a positive end-expiratory pressure (PEEP) of 6 cmH₂O on the first day of assessment. These assessment findings are consistent with the theory that patients with an ETT are at high risk of secretion retention due to impaired physiological coughing mechanisms. An artificial airway can interfere with mucociliary function, resulting in the accumulation of secretions in the respiratory tract and increasing the risk of impaired ventilation (Noho R et al., 2023). Furthermore, the patient's post-craniotomy condition due to intracerebral hemorrhage may cause decreased consciousness and respiratory muscle weakness, thereby further impairing the patient's ability to effectively clear the airway (Yunus et al., 2025).

Nursing Diagnosis

Based on the assessment findings, the nursing diagnosis established in this case was impaired ventilator weaning related to impaired respiratory effort (respiratory muscle weakness). This diagnosis was established based on objective data, including the use of mechanical ventilation, increased respiratory rate, the use of accessory respiratory muscles, the presence of rhonchi, and increased sputum production.

This diagnosis is consistent with the Indonesian Nursing Diagnosis Standards (Tim Pokja SDKI DPP PPNI, 2016), which states that impaired ventilator weaning is a condition in which patients experience difficulty maintaining spontaneous ventilation after the use of mechanical ventilation. Impaired ventilator weaning is generally influenced by several factors, including respiratory muscle weakness, secretion retention, impaired oxygenation, and the use of an ETT, which may inhibit the cough reflex.

Nursing Intervention

The nursing interventions in this case focused on maintaining airway patency and supporting successful ventilator weaning through chest physiotherapy and deep suctioning. These interventions were selected because both procedures have been shown to be effective in facilitating secretion mobilization and improving pulmonary ventilation in mechanically ventilated patients (Tim Pokja SIKI DPP PPNI, 2018).

Chest physiotherapy was performed using postural drainage, percussion (clapping), and vibration techniques for 5–10 minutes in areas with accumulated secretions. These procedures aimed to facilitate the mobilization of secretions from the peripheral airways toward the larger airways, making them easier to remove (Ristyowati & Aini, 2023). Meanwhile, deep suctioning was performed by inserting a suction catheter beyond the tip of the endotracheal tube to remove secretions from the lower respiratory tract using negative pressure (Noho R et al., 2023).

Previous research has demonstrated that a combination of chest physiotherapy and suctioning can increase oxygen saturation, reduce sputum production, and improve respiratory patterns in mechanically ventilated patients (Maylinda et al., 2024).

Nursing Implementation

The interventions were implemented for three consecutive days, from January 15 to 17, 2026, twice daily, in the morning and afternoon. Chest physiotherapy was performed first to facilitate secretion mobilization through lateral positioning, percussion, and vibration techniques. After the secretions had been mobilized, the intervention was continued with deep suctioning through the ETT to remove secretions from the airway.

The procedures were performed in accordance with aseptic, safe, and atraumatic principles to prevent complications during suctioning. Throughout the procedures, the nurse also monitored respiratory parameters, including oxygen saturation, respiratory rate, and the patient's response to the interventions provided. This approach is consistent with evidence-based practice, which indicates that a combination of chest physiotherapy and deep suctioning can improve the effectiveness of airway clearance and support alveolar ventilation in mechanically ventilated patients (Alpiah et al., 2025).

Nursing Evaluation

The evaluation results over the three-day period demonstrated significant improvement in several respiratory parameters. The PEEP value gradually decreased from 6 cmH₂O on the first day to 5 cmH₂O on the second day and 4 cmH₂O on the third day. The decrease in PEEP indicated improved pulmonary ventilation and a reduced requirement for mechanical ventilatory support.

The patient's respiratory rate also decreased from 32 breaths/minute at the initial assessment to 12 breaths/minute at the end of the observation period. In addition, the use of accessory respiratory muscles and shallow breathing, which were initially observed on the first day, were no longer present on the following days. Pulmonary auscultation also showed that the rhonchi initially heard on the first day were no longer detected on the second and third days.

Sputum production decreased significantly from 220 cc on the first day to 30 cc on the third day. This finding indicates that chest physiotherapy and deep suctioning were effective in facilitating the mobilization and removal of secretions from the respiratory tract. In addition, the patient's oxygen saturation increased and remained stable at 99–100%, indicating improved oxygenation.

These findings are consistent with the study by Yunus et al. (2025), which reported that chest physiotherapy had a significant effect on increasing oxygen saturation in mechanically ventilated patients. Another study also demonstrated that properly performed suctioning can improve airway patency and reduce secretion accumulation in patients with ETTs (Apui et al., 2023).

A study conducted by Noho R et al. (2023) showed that deep suctioning had an effect on changes in oxygen saturation among patients with ETTs in the ICU of Tani and Nelayan Regional Hospital, Boalemo Regency. The study by Maylinda et al. (2024) further supports these findings, demonstrating that the application of combined chest physiotherapy and suctioning in a patient identified as Mr. M resulted in increased oxygen saturation and decreased sputum production.

Overall, the evaluation findings indicate that the routine and structured administration of chest physiotherapy and deep suctioning was able to improve the patient's respiratory function, maintain airway patency, and support successful ventilator weaning in a post-craniotomy patient.

Conclusion

The implementation of chest physiotherapy and deep suction based on the Indonesian Nursing Outcome Standards (SLKI) and Indonesian Nursing Intervention Standards (SIKI), performed systematically over 3 × 24 hours, demonstrated meaningful improvements in respiratory parameters, including increased oxygen saturation, reduced sputum production, improved respiratory rate and effort, and better ventilator synchrony. These findings support the importance of evidence-based nursing interventions in facilitating ventilator weaning and maintaining airway patency in post-craniotomy patients with endotracheal tubes (ETTs) in the ICU. Consistent implementation accompanied by close monitoring of clinical parameters may contribute to respiratory stability and support safe and gradual ventilator weaning.

References

- Agustiani, S. (2024). *Faktor-Faktor Yang Mempengaruhi Kemampuan Perawat Dalam Menangani Pasien Cedera Kepala DI IGD*. <http://jurnal.globalhealthsciencegroup.com/index.php/JPPP>
- Alam, A. R., Suhada, M. W., Nduru, A. F., Rosnelly, R., Setiawan, A., & Potensi Utama Medan, U. (2025). Klasifikasi Jenis Tumor Otak pada Citra MRI Menggunakan Convolutional Neural Network (CNN). *Remik: Riset Dan E-Jurnal Manajemen Informatika Komputer*, 9(4). <https://doi.org/10.33395/remik.v9i4.15020>
- Apui, S. S., Wiyadi, W., & Arsyawina, A. (2023). Pengaruh Tindakan Suction Terhadap Perubahan Saturasi Oksigen Pada Pasien Penurunan Kesadaran Di Ruang ICU RSD dr. H. Soemarno Sostroatmodjo. *Aspiration of Health Journal*, 1(1), 45–52. <https://doi.org/10.55681/aohj.v1i1.84>
- Feigin, V. L., Brainin, M., Norrving, B., Martins, S. O., Pandian, J., Lindsay, P., F Grupper, M., & Rautalin, I. (2025). World Stroke Organization: Global Stroke Fact Sheet 2025. In *International Journal of Stroke* (Vol. 20, Number 2, pp. 132–144). SAGE Publications Inc. <https://doi.org/10.1177/17474930241308142>
- Kementerian Kesehatan RI. (2018). *Riskesdas*.
- Maylinda, I., Pujiastuti, D., Bethesda Yakkum Yogyakarta, S., & Bethesda Yogyakarta, R. (2024). *Efektivitas Kombinasi Nebulizer Dan Fisioterapi Dada Dengan Open Suction Pada Tn. M Dengan Gagal Napas Terpasang Endotracheal Tube Terhadap Bersihan Jalan Napas Di Salah Satu Rumah Sakit Swasta Yogyakarta: Case Report*.
- Noho R, Lasanudin V, & Fadli S. (2023). Pengaruh Deep Suction Terhadap Perubahan Saturasi Oksigen Di Ruang Intensive Care Unit (ICU) RSUD Tani dan Nelayan Kabupaten Boalemo. *Jurnal Riset Rumpun Ilmu Kedokteran*, 2.

- Pratama, N., Liebenlito, M., Irene, Y., Sains, F., Teknologi, D., Syarif, U., & Jakarta, H. (2024). Perbandingan Model Klasifikasi Transfer Learning Convolutional Neural Network Tumor Otak Menggunakan Citra Magnetic Resonance Imaging. *Jurnal Sehat Indonesia*, 6(1).
- Ristyowati¹, E., & Aini², D. N. (2023). Penerapan Fisioterapi Dada Terhadap Pengeluaran Sputum Untuk Ketidakefektifan Bersihan Jalan Nafas Pada Pasien Penyakit Paru Obstruktif Kronik (Ppok) Application Of Chest Physiotherapy To Sputum Expense For Ineffectiveness Of Airway Cleansing In Chronic Obstructive Pulmonary Disease (Copd) Patients. 5(1), 108–115.
- Rosyida, F. N., & Arofiati, F. (2025). Penerapan Terapi Murottal Dan Posisi Semi Fowler Pada Pasien Post Kraniotomi Stroke ICH: Studi Kasus Application Murottal Therapy And Semi Fowler Position In Post Craniotomy Stroke Patient ICH: Case Study. *Jurnal Kesehatan Medika Saintika*, 16(1). <https://doi.org/10.30633/jkms.v16i1.3183>
- Tim Pokja SDKI DPP PPNI. (2016). *Standar Diagnosa Keperawatan Indonesia* (DPP PPNI, Ed.; Edisi 1).
- Tim Pokja SIKI DPP PPNI. (2018). *Standar Intervensi Keperawatan Indonesia* (Edisi 1). DPP PPNI .
- Yunus, P., Monoarfa, S., & Yahya, A. (2025). Pengaruh Fungsi Fisioterapi Dada pada Pasien Penurunan Kesadaran yang terpasang Ventilasi Mekanik terhadap Perubahan Saturasi Oksigen di Ruang ICU RSUD Dr. M.M Dunda Limboto. *Malahayati Nursing Journal*, 7(8), 3568–3580. <https://doi.org/10.33024/mnj.v7i8.21652>