

Active cycle of breathing technique and chest physiotherapy on the effectiveness of airway clearance

Ciclo activo de la técnica respiratoria y la fisioterapia torácica sobre la eficacia de la limpieza de las vías respiratorias

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SUMMARY

Introduction: Ineffective airway clearance begins with the accumulation of secretions in the respiratory tract. This is one of the main causes of respiratory disorders such as shortness of breath, rhonchi, and wheezing. **Objective:** This study aimed to analyze the effect of combining Active Breathing Cycle Technique (ACBT) and chest physiotherapy on the ineffectiveness of airway clearance in Chronic Obstructive Pulmonary Disease (COPD). **Methods:** This study design was quasi-experimental with a pretest-posttest and a control group. This design involved two groups: the intervention group with ACBT and chest physiotherapy, and the control group. Data collection was carried out using direct observation sheets and medical records. Kruskal-Wallis test for overall comparison and the Mann-Whitney U test for pairwise comparisons. The p-value was 0.0001, indicating a difference in airway clearance scores between the intervention and control groups in the delta/change data. **Results:** Based on the average value, the airway clearance score for the intervention group was obtained. The increase in score was greater than that of the control group

during the delta/change data. The combined ACBT and chest physiotherapy intervention was superior to either intervention alone. Furthermore, nurses in the clinic began learning and implementing the combined ACBT and chest physiotherapy intervention to address airway-clearance limitations and to maintain quality nursing care.

Keywords: Airway breathing cycle techniques, Chest Physiotherapy, Ineffective, respiratory

RESUMEN

Introducción: La limpieza ineficaz de las vías respiratorias comienza con la acumulación de secreciones en el tracto respiratorio. Esta es una de las principales causas de trastornos respiratorios como disnea, roncus y sibilancias. **Objetivo:** Analizar el efecto de la combinación de la Técnica del Ciclo Respiratorio Activo (ACBT) y la fisioterapia torácica sobre la ineficacia de la limpieza de las vías respiratorias en la Enfermedad Pulmonar Obstructiva Crónica (EPOC). **Método:** El diseño de este estudio fue cuasiexperimental, con un pretest-posttest y un grupo de control. Este diseño incluyó dos grupos: el de

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intervención (ACBT y fisioterapia torácica) y el control. La recopilación de datos se realizó mediante hojas de observación directa y registros médicos. Además, se utilizó la prueba de Mann-Whitney. El valor p fue de 0,0001, lo que indica una diferencia en las puntuaciones de limpieza de las vías respiratorias entre los grupos de intervención y control en los datos delta/cambio.

Resultados: *Con base en el valor promedio, se obtuvo la puntuación de limpieza de las vías respiratorias del grupo de intervención. El aumento de la puntuación fue mayor que en el grupo de control durante el análisis de cambios. La intervención combinada de ACBT y fisioterapia torácica fue superior a cualquiera de las intervenciones por separado. Además, el personal de enfermería de la clínica comenzó a aprender e implementar la intervención combinada de ACBT y fisioterapia torácica para abordar las limitaciones en la limpieza de las vías respiratorias y mantener una atención de enfermería de calidad.*

Palabras clave: *Técnicas del ciclo respiratorio de las vías respiratorias, fisioterapia torácica, ineficaz, respiratoria*

INTRODUCTION

Airway dysfunction often results from excessive mucus production in the lungs (1). As this mucus accumulates in the respiratory tract, it becomes progressively thicker and more viscous, making its clearance increasingly difficult (2). The resulting obstruction disrupts gas exchange, impairing both carbon dioxide elimination and adequate oxygenation (3). If the reduction in oxygen supply is not addressed promptly, it may rapidly progress to hypoxia, severe hypoxemia, decreased consciousness, and ultimately death (4).

Comprehensive and multidisciplinary nursing interventions can address a wide range of patient needs related to activities of daily living (ADLs) (5). However, these interventions alone are insufficient to resolve problems associated with ineffective airway clearance (6). Therefore, targeted management of dyspnea is required to restore physiological stability and reduce patient discomfort (7). Strategies to improve airway clearance and minimize the accumulation of secretions in the respiratory tract can be effectively implemented by combining the Active Cycle of Breathing Techniques (ACBT) with chest physiotherapy (8,9).

Airway clearance techniques (ACT) enhance mucociliary transport by facilitating the mobilization and removal of mucus from the lungs, thereby improving airway effectiveness (10). These techniques act, in part, by modifying the viscoelastic properties of respiratory secretions and optimizing gas-liquid interactions within the airways, thereby supporting more efficient mucus clearance (11,12). Through the application of ACT, patients can achieve more effective coughing, improved quality of life, and better tolerance for regular physical activity (13). In adults, airway effectiveness has been shown to improve significantly when ACT is combined with techniques that promote an effective cough (14).

The use of the Active Cycle of Breathing Techniques (ACBT) combined with chest physiotherapy as an intervention to address ineffective airway clearance in patients with Chronic Obstructive Pulmonary Disease (COPD) has not been previously investigated. This gap in the literature positions the present study as a novel contribution to evidence based nursing practice.

RESEARCH METHODS

A quasi experimental research design employing a pretest-posttest control group approach was used. Data collection was conducted from October 2023 to June 2024 in hospitals located in East Java, Indonesia. The study population consisted of inpatients diagnosed with respiratory disorders who were admitted to one of the selected hospitals. The hospital chosen as the research site agreed to collaborate with the research team, was easily accessible, and had a sufficient number of patients experiencing respiratory problems. Prior to data collection, the study protocol underwent ethical review and was approved under registration number 0023/016/EC/KEP/LCBL/2024.

Participants

The population in this study consisted of hospitalized patients with impaired respiratory function at one of the selected hospitals in East

Java, Indonesia. A total sample of 40 respondents was obtained using a non probability sampling technique, with 20 participants assigned to the intervention group and 20 to the control group. Inclusion criteria were adult patients aged 20 years or older, diagnosed with respiratory disorders, experiencing shortness of breath, fully conscious, and not diagnosed with pulmonary tuberculosis. Exclusion criteria included patients with respiratory disorders accompanied by comorbid conditions, individuals with hypertension, and patients with bone fractures.

The independent variable in this study was the combined intervention of the Active Cycle of Breathing Techniques (ACBT) and chest physiotherapy, delivered to respondents through a structured smart book guide. The dependent variable was the level of ineffective airway clearance. Data were collected using a questionnaire that included items assessing clapping techniques, secretion mobilization actions, and chest physiotherapy procedures. Responses were measured on a five-category Likert scale: very rarely, rarely, sometimes, often, and very frequently. Vital signs were assessed using an observation checklist that included respiratory rate, pulse, blood pressure, and the presence of rhonchi. Instrument validity testing yielded p values greater than 0.564, indicating acceptable item validity, while reliability testing produced Cronbach's alpha values above 0.547, demonstrating adequate internal consistency. Data analysis employed the Kruskal–Wallis test for overall group comparisons, followed by the Mann–Whitney U test for post hoc pairwise analyses.

RESULTS

As shown in Table 1, the demographic characteristics of participants in the treatment and control groups were comparable across all measured variables. Gender distribution did not differ significantly between groups, with men representing 40% of the treatment group and 50% of the control group, and women comprising 60% and 50%, respectively ($p = 0.751$). Age

characteristics were also similar. Participants in the treatment group ranged from 22 to 66 years (median 49.5; mean 48.10 ± 10.07), while those in the control group ranged from 35 to 52 years (median 44.5; mean 45.88 ± 8.49). The Kruskal–Wallis test indicated no significant difference in age distribution ($p = 0.061$).

Educational attainment was likewise balanced between groups. Junior high school graduates accounted for 20% of the treatment group and 30% of the control group, high school graduates for 60% and 50%, and diploma holders for 20% in both groups. The equality test confirmed no significant difference in education level ($p = 0.631$). Occupational status also showed no meaningful variation between groups: farmers represented 25% of the treatment group and 30% of the control group, private sector workers 65% and 50%, and government employees 10% and 20%, respectively. The equality test again showed no significant difference ($p = 0.563$).

Overall, all demographic variables demonstrated p values greater than 0.05, indicating that the treatment and control groups were statistically equivalent. These findings confirm that demographic characteristics were not confounding factors in this study.

Table 2 describes the effectiveness of airway clearance in both the treatment and control groups before and after the intervention. At the pretest stage, all participants in both groups demonstrated ineffective airway clearance, with scores ranging from 0 to 1. The median score was 0 in the treatment group and 0.5 in the control group, and mean scores were similarly low (0.30 ± 0.47 and 0.50 ± 0.51 , respectively). No participants in either group were categorized as “quite effective” or “effective” prior to the intervention, confirming that both groups began the study with equally impaired airway clearance.

Following the intervention, substantial improvements were observed in both groups, although the magnitude of improvement differed. In the treatment group, posttest airway clearance scores ranged from 7 to 8, with a median of 7 and a mean of 7.45 ± 0.51 . All participants (100%)

Table 1. Distribution of demographic characteristics and equality test in treatment and control groups

Characteristic Subyek	Group			P value
	Treatment (n=20)	Control (n=20)	Total (40)	Equality
Gender				
Man	8 (40.0%)	10 (50.0%)	18 (45.0%)	0.751 ^a
Woman	12 (60.0%)	10 (50.0%)	22 (55.0%)	
Age				
Range (Median)	22 – 66 (49.50)	35 – 52 (44.50)	22 - 66 (47.50)	0.061 ^b
Mean ± SD	48.10 ± 10.07	43.65 ± 6.02	45.88 ± 8.49	
20-29 Th	1 (5.0%)	0 (0%)	1 (2.5%)	
30-39 Th	3 (15.0%)	8 (40.0%)	11 (27.5%)	
40-49 Th	6 (30.0%)	7 (35.0%)	13 (32.5%)	
50-60 Th	9 (45.0%)	5 (25.0%)	14 (35.0%)	
≥60 Th	1 (5.0%)	0 (0%)	1 (2.5%)	
Education				
Junior high school	4 (20.0%)	6 (30.0%)	10 (25.0%)	0.631 ^b
High school	12 (60.0%)	10 (50.0%)	22 (55.0%)	
Diploma	4 (20.0%)	4 (20.0%)	8 (20.0%)	
Work				
Farmer	5 (25.0%)	6 (30.0%)	22 (27.5%)	0.563 ^a
Private	13 (65.0%)	10 (50.0%)	23 (57.5%)	
Gowernment	2 (10.0%)	4 (20.0%)	6 (15.0%)	

in this group achieved an effective level of airway clearance after receiving the combined ACBT and chest physiotherapy intervention.

The control group also showed improvement, with posttest scores ranging from 5 to 8 (median 6.5; mean 6.55 ± 0.99). However, only half of the participants (50%) reached the “effective” category, while the remaining 50% were classified as “quite effective.” No participants in either group remained ineffective after the intervention.

The change scores (delta) further highlight the difference in treatment effect. The treatment

group demonstrated a mean improvement of 7.15 ± 0.67 , compared with 6.05 ± 0.83 in the control group. This indicates that although both groups improved, the treatment group experienced a greater overall increase in airway clearance effectiveness.

Overall, the descriptive findings in Table 2 indicate that the combined ACBT and chest physiotherapy intervention produced more pronounced improvements in airway clearance than the standard care received by the control group.

Table 2. Descriptive effectiveness of airway clearance in treatment and control groups

	Group		Total (40)
	Treatment (n=20)	Control (n=20)	
Pre			
Range (Median)	0 - 1 (0)	0 - 1 (0.5)	0 - 1 (0)
Mean \pm SD	0.30 \pm 0.47	0.50 \pm 0.51	0.40 \pm 0.49
Ineffective	20 (100%)	20 (100%)	40 (100%)
Quite Effective	0 (0%)	0 (0%)	0 (0%)
Effective	0 (0%)	0 (0%)	0 (0%)
Post			
Range (Median)	7 - 8 (7)	5 - 8 (6.5)	5 - 8 (7)
Mean \pm SD	7.45 \pm 0.51	6.55 \pm 0.99	7.00 \pm 0.91
Ineffective	0 (0%)	0 (0%)	0 (0%)
Quite Effective	0 (0%)	10 (50.0%)	10 (25.0%)
EffectiveEffective	20 (100%)	10 (50.0%)	30 (75.0%)
Delta			
Range (Median)	6 - 8 (6)	5 - 7 (6)	5 - 8 (7)
Mean \pm SD	7.15 \pm 0.67	6.05 \pm 0.83	6.60 \pm 0.93

Table 3 presents the results of the ACBT and chest physiotherapy intervention based on airway clearance scores in the treatment and control groups. At baseline, both groups demonstrated similarly low airway clearance scores, with mean pretest values of 0.30 \pm 0.47 in the treatment group and 0.50 \pm 0.51 in the control group. The difference between groups at pretest was not statistically significant ($p = 0.202$), confirming that both groups began the study with comparable levels of airway clearance impairment.

Following the intervention period, both groups showed significant improvements in airway clearance. The treatment group, which received the combined ACBT and chest physiotherapy

intervention, demonstrated a substantial increase in mean airway clearance score to 7.45 \pm 0.51. The control group also improved, reaching a mean posttest score of 6.55 \pm 0.99. Within group comparisons indicated that these improvements were statistically significant for both groups ($p = 0.0001$).

However, the magnitude of improvement differed between groups. The posttest comparison revealed a statistically significant difference in favor of the treatment group ($p = 0.003$). This indicates that the combined ACBT and chest physiotherapy intervention was more effective in improving airway clearance than the standard care received by the control group.

Table 3. Results of ACBT and Chest Physiotherapy interventions based on airway clearance inefficiency scores

Variable	Group	Pre test	Post test	<i>p</i> -value
		Mean ± SD	Mean ± SD	
Airway Clearance Score	Treatment	0.30 ± 0.47	7.45 ± 0.51	0.000 ^b
	Control	0.50 ± 0.51	6.55 ± 0.99	0.000 ^b
	<i>p</i> -value	0.202 ^a	0.003 ^a	

Overall, the findings in Table 3 demonstrate that while both groups experienced meaningful improvements, the intervention group achieved superior airway clearance outcomes, supporting the effectiveness of ACBT combined with chest physiotherapy in addressing ineffective airway clearance.

DISCUSSION

The findings of this study show that both the intervention and control groups experienced significant improvements in airway clearance from pretest to posttest; however, the magnitude of improvement was substantially greater in the group receiving the combined Active Cycle of Breathing Techniques (ACBT) and chest physiotherapy. The Mann–Whitney U test demonstrated a significant difference between pretest and posttest scores in the control group ($p = 0.0001$), indicating that standard care alone contributed to some improvement in airway clearance (Table 3). Nevertheless, the intervention group exhibited a markedly greater increase in airway clearance scores, confirming that ACBT, combined with chest physiotherapy, effectively addressed airway inefficiency in COPD patients (15).

The superior outcomes observed in the intervention group can be explained by the physiological mechanisms of ACBT and chest physiotherapy. ACBT has been shown to reduce shortness of breath by decreasing respiratory rate and increasing oxygen saturation (SpO_2), thereby improving ventilation efficiency (16). The technique enhances chest expansion, allowing the thoracic cage and lungs to expand more effectively

and contributing to improved gas exchange and overall respiratory function. As lung expansion increases, patients often experience improvements in comfort and quality of life.

Chest physiotherapy further supports airway clearance by reducing mucus accumulation in the respiratory tract (15,17). Techniques such as percussion and vibration generate oscillatory forces that help loosen secretions adhering to the bronchial walls (18). This vibratory effect facilitates the mobilization of mucus toward the larger airways, where it can be expelled through effective coughing (19,20). Together, ACBT and chest physiotherapy enhance mucociliary clearance, reduce airway obstruction, and alleviate dyspnea, consistent with previous evidence demonstrating their effectiveness in improving airway patency (21).

The increase in oxygen saturation observed in the control group suggests that improvement was not solely attributable to the intervention. Physiological compensatory mechanisms—such as increased alveolar ventilation and optimized pulmonary perfusion—may have contributed to improved oxygenation. These natural adaptive responses help maintain tissue oxygen delivery when respiratory function is compromised. Additionally, individual health characteristics, including younger age, milder disease severity, and better baseline functional status, may have supported recovery even without specialized intervention.

The combined intervention also demonstrated clinical benefits beyond airway clearance. The disappearance of rhonchi by the third day in

the intervention group (23) indicates successful mobilization and removal of secretions. Rhonchi are produced by airflow through mucus filled airways (24), and their resolution suggests effective clearance of sputum through chest physiotherapy and effective coughing (25). Chest physiotherapy aims to clear the airways (26) and increase airway effectiveness by removing accumulated mucus (27), which aligns with the improvements observed in this study.

The significant posttest difference between the intervention and control groups ($p = 0.003$) confirms that ACBT and chest physiotherapy had a measurable and clinically meaningful effect on airway clearance effectiveness (Table 3). These findings are consistent with previous studies showing that ACBT reduces respiratory rate in COPD patients (28), reduces dyspnea in patients with pulmonary tuberculosis (30), and enhances mucus clearance when combined with chest physiotherapy (31). The breathing techniques used in ACBT help mobilize mucus from the alveoli (5), while chest physiotherapy techniques such as postural drainage and vibration facilitate mucus excretion through effective coughing (32). Together, these mechanisms reduce shortness of breath in COPD patients by clearing mucus that accumulates in the airways (17,33).

Environmental and psychological factors may also have influenced patient outcomes. Good air quality, comfortable temperature, and minimal exposure to pollutants support optimal respiratory function, while emotional stability and reduced anxiety can improve breathing patterns and oxygen saturation. These contextual factors may explain some of the improvements observed in both groups.

Overall, the results of this study provide strong evidence that the combined application of ACBT and chest physiotherapy is an effective nursing intervention for improving airway clearance in COPD patients. By enhancing mucus mobilization, reducing dyspnea, and improving oxygenation, this intervention contributes to better respiratory function and may enhance patients' quality of life.

CONCLUSION

The combined application of the Active Cycle of Breathing Techniques (ACBT) and chest physiotherapy proved effective in improving airway clearance in patients with mucus accumulation in the respiratory tract. The intervention successfully facilitated the mobilization and removal of secretions, resulting in the resolution of airway obstruction and improved respiratory function. These findings indicate that ACBT and chest physiotherapy represent highly promising and evidence based nursing strategies for managing airway clearance inefficiency, particularly in patients with chronic respiratory conditions such as COPD. By enhancing mucus clearance and reducing dyspnea, this combined approach contributes meaningfully to improved patient outcomes and overall quality of life.

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Conflict of interest

In this study, there was no conflict of interest.

REFERENCES

1. Selsby D, Jones JG. Some physiological and clinical aspects of chest physiotherapy. Vol. 64, British Journal of Anaesthesia. Oxford University Press; 1990. p. 621–31.

2. Schans Cees P van der. Conventional chest physical therapy for obstructive-3. *Respir Care*. 2017;52:1198–209.
3. Jennifer A, Pryor BAW. Patient information factsheet: The active cycle of breathing technique (ACBT). United Kingdom; 2001. Available from: www.uhs.nhs.uk
4. Kirsten M. Active Cycle of Breathing Technique (ACBT): What is ACBT? UK; 2019.
5. Visca D, Zampogna E, Sotgiu G, D'Ambrosio R, Centis R, Saderi L, Pegoraro V, et al. Pulmonary rehabilitation is effective in patients with tuberculosis pulmonary sequelae. *Eur Respir J*. 2019;53(3):1801521.6.
7. Khikmatul Aeni N. Implementation of Chest Physiotherapy in Children with Tuberculosis to Manage Ineffective Airway Clearance Implementation of Chest Physiotherapy in Children with Tuberculosis to Manage Ineffective Airway Clearance. *Genius Journal*. 2022;03(01):73–8.
8. Suryarinilsih Y, Netti N, Budi H. Deep Breathing and Coughing Techniques are Effective for Airway Clearance in Patients with Pulmonary Tuberculosis. *International Journal of Current Science Research and Review*. 2023;06(04).
9. Wahyudi DA, Nike XANS, Hamid P. Active Cycle of Breathing to respiratory rate in patients with lung tuberculosis. *International Journal of Pharmaceutical Research*. 2021;13(1):1–6.
10. Windiastoni YH, Basuki N, Haritsah NF. Effects of Chest Physiotherapy and Effective Cough Exercise on Sputum Clearance and Respiratory Frequency in Tuberculosis Patients. *Journal of Epidemiology and Public Health*. 2023;8(4):527–32.
11. Britton S, Bejsted M, Vedin L. Chest physiotherapy in primary pneumonia. *British Medical Journal*. 1985; 290.
12. Alfarizi M, Juliningrum PP, Sulistyorini L, Primirti ID. Combination of Chest Physiotherapy and Postural Drainage for Airway Clearance in Bronchopneumonia: A Case Study. *Jurnal Kegawatdaruratan Medis Indonesia*. 2024;3(1):76–89.
13. Coventry and Warwickshire. Chest physiotherapy: Cough augmentation techniques. 2023.
14. Boggild MK, Tomlinson G, Erlandson MC, Szabo E, Giangregorio LM, Craven BC, et al. Effects of Whole-Body Vibration Therapy on Distal Tibial Myotendinous Density and Volume: A Randomized Controlled Trial in Postmenopausal Women. *JBMR Plus*. 2019;3(5):1–8.
15. Ahmed IM. Effect of Mechanical Chest Vibration during Chest Physiotherapy on Ventilator Parameters and Oxygen Saturation in Mechanically Ventilated Patients. *International Egyptian Journal of Nursing Sciences and Research*. 2024;4.
16. Scanlan CL M. Procedure-Chest Physiotherapy. 2023.
17. Fernández Guerrero ML, Díaz Fernández JL, de Miguel Prieto J, Gómez Garcés JL. Community-acquired *Acinetobacter pneumonia*. *Chest*. 1980;78:670.
18. Wong Pong Wai. Physical Therapy for a Patient in Acute Respiratory Failure. Singapore; 2000. Available from: <https://academic.oup.com/ptj/article/80/7/662/2842497>
19. Connors AF, Hammon WE, Martin RJ, Rogers RM. Chest physical therapy. The immediate effect on oxygenation in acutely ill patients. *Chest*. 1980;78(4):559–64.
20. Templeton M, Palazzo MGA. Chest physiotherapy prolongs duration of ventilation in the critically ill ventilated for more than 48 hours. *Intensive Care Med*. 2007;33(11):1938–45.
21. dos Santos RS, Donadio MVF, da Silva G V., Blattner CN, Melo DAS, Nunes FB, et al. Immediate effects of chest physiotherapy on hemodynamic, metabolic, and oxidative stress parameters in subjects with septic shock. *Respir Care*. 2014;59(9):1398–403.
22. Abdeen HA, Saad, Elgendy M, Nagy, Nassef L, Soliman YMA. Acute Effect of Chest Physical Therapy on Arterial Blood Gases for Mechanical Ventilated Patients. *Cairo Univ*. 2020;88. Available from: www.medicaljournalofcairouniversity.net
23. Longhini F, Bruni A, Garofalo E, Ronco C, Gusmano A, Cammarota G, et al. Chest physiotherapy improves lung aeration in hypersecretive critically ill patients: A pilot randomized physiological study. *Crit Care*. 2020;24(1).
24. Meawad MA, Abd El Aziz A, Obaya HE, Mohamed SA, Mounir KM. Effect of Chest Physical Therapy Modalities on Oxygen Saturation and Partial Pressure of Arterial Oxygen in Mechanically Ventilated Patients. *Egypt J Hosp Med*. 2018;72(8):5005–8.
25. Tenggara A. Penerapan Fisioterapi Dada Dan Batuk Efektif Untuk The Application Of Chest And Cough Physiotherapy Is Effective In Overcoming Ibeffective Airway Clearance Kurnia, Penerapan Fisioterapi Dada Tuberkulosis atau TB adalah penyakit infeksius yang menyerang ke. 2021;1:204–8.
26. Ambrosino N, Venturelli E, Vaghegghini G, Clini E. Rehabilitation, weaning and physical therapy strategies in chronic critically ill patients. *European Respiratory Journal*. 2012;39: 487–92.
27. Carney N, Cheney T, Totten AM, Jungbauer R, Neth MR, Weeks C, et al. Prehospital Airway

- Management: A Systematic Review. 2021. Available from: <https://effectivehealthcare.ahrq.gov/products/prehospital-airway-management/research>
28. British Lung Foundation. Association of Chartered Physiotherapists in Respiratory Care UK; 2011. Available from: www.brit-thoracic.org.uk/clinical-information/physiotherapy/physiotherapy-guideline.aspx
 29. Varida Naibaho EN, Herlina Kabeakan SM. Pengaruh Terapi Active Cycle of Breathing Technique (Acbt) Terhadap Frekuensi Pernafasan (Respiratory Rate) Pada Penderita Tuberkulosis Paru Di Rumah Sakit Umum Imelda Pekerja Indonesia Medan. Indonesian Trust Health Journal. 2021;4(2):499–506.
 30. Iwanicka E, Więch P, Sałacińska I, Przybek-Mita J. Effectiveness of selected alternative methods of airway management by the nursing staff. *Pielęgniarstwo XXI Wieku*. 2021;20(2):89–94.
 31. Luies L, Preez I du. The echo of pulmonary tuberculosis: Mechanisms of clinical symptoms and other disease-induced systemic complications. *Clinical Microbiology Reviews*. American Society for Microbiology; 2020;33: 1–19.
 32. Domingos Moreira A. Nursing Actions in Patients TB-Pulmonary with Airway Ineffectiveness Disorders. 2023.
 33. Reshia FAA, Salameh B, Alsadaan N, Alqahtani M, Ayed A, Kassabry MF, et al. Enhancing pulmonary function and arterial blood gas readings through immediate chest physiotherapy among extubated patients in ICU. *Journal of International Medical Research*. 2023;51(11).