NCIJ 3 (2) (2025)
Nursing Case Insight Journal
Journal of Case Study Nursing
https://nci.journalhealth.org/index.php/nci

Application of Pursed-Lip Breathing in a Patient with Right-sided Pneumothorax (Pneumothorax Dextra): a Case Report

Yuni Nur'aeni[1*], Eka Afrima Sari[2], Hesti Platini[3]
[1] Professional Nurse Program, Faculty of Nursing, Padjadjaran University, Bandung, West Java, Indonesia
[2,3] Department of Medical-Surgical Nursing, Faculty of Nursing, Padjadjaran University, Bandung, West Java, Indonesia

Abstract: Pneumothorax is a condition in which air enters the pleural cavity of the lungs, potentially disrupting the respiratory process. A common clinical manifestation is severe shortness of breath during inspiration. Pursed-lip breathing is a non-pharmacological therapy that can relax the respiratory muscles and reduce dyspnea. This study aims to examine the application of pursed-lip breathing in a patient with pneumothorax and its effect on respiratory status. Mr. X, a 70-year-old fisherman, was admitted to the hospital with complaints of severe shortness of breath and difficulty breathing. The patient was medically diagnosed with right-sided pneumothorax due to ruptured bleb, suspected to be caused by chronic active pulmonary tuberculosis. A chest tube thoracostomy (CTT) procedure was performed. The patient had a 55-year history of smoking 1.5-2 packs of cigarettes per day. This case report employed a nursing care approach. The intervention administered was pursed-lip breathing, conducted over three days with three repetitions per session. The evaluation focused on respiratory rate, oxygen saturation, and the level of dyspnea based on the Modified Borg Scale and the Modified Medical Research Council (mMRC) Dyspnea Scale. Evaluation results showed a decrease in respiratory rate from 25 to 21 breaths per minute and an increase in oxygen saturation from 94% to 97%. Additionally, dyspnea severity decreased from a Borg score of 3 to 2 and from mMRC grade 2 to grade 1 following the intervention. Pursed-lip breathing can improve respiratory status and reduce dyspnea, suggesting its potential as a non-pharmacological therapy for patients with pneumothorax.

Keywords: Dyspnea; pneumothorax; pursed lip breathing.

Received: 23 June 2025
Revised: 30 June 2025
Accepted: 2 July 2025
Published: 12 August 2025

Corresponding Author: Yuni Nur'aeni
Author Name*: Yuni Nur'aeni
Email*: yuni20001@mail.unpad.ac.id

DOI: https://doi.org/10.63166/px7kvw55

© 2025 The Authors. This open access article is distributed under a (CC-BY License)

Phone*: +6287723752309

Introduction

Secondary spontaneous pneumothorax (SSP) is a complication resulting from an underlying pulmonary disease, typically caused by the rupture of blebs or air sacs and alterations in connective tissue, leading to air leakage into the pleural cavity (Costumbrado & Kim, 2017). Underlying conditions that may lead to SSP include chronic obstructive pulmonary disease (COPD), pulmonary tuberculosis, asthma, pneumonia, and other infections caused by bacteria such as *Klebsiella*, *Staphylococcus*, *Pseudomonas*, and anaerobic organisms (Costumbrado & Kim, 2017; Huan et al., 2021). Risk factors include age over 50 years, history of pulmonary disease, and a history of smoking (Huan et al., 2021). Heavy smokers have a 102-fold higher risk of developing pneumothorax compared to passive smokers. The likelihood of recurrent pneumothorax is

How to Cite: Nur'aeni, Y., Sari, E. A., & Platini, H. (2025). Application of Pursed-Lip Breathing in a Patient with Right-sided Pneumothorax (Pneumothorax Dextra): a Case Report. *Nursing Case Insight Journal*, *3*(2), 44-52. https://doi.org/10.63166/px7kvw55

also associated with the number of cigarettes smoked daily (Atika & Rosfadilla, 2025).

Secondary spontaneous pneumothorax occurs more frequently in adults, particularly males, with an incidence ranging from 7 to 18 cases per 100,000 males (Costumbrado & Kim, 2017; Onuki et al., 2017). A study conducted in the United Kingdom reported that men experience secondary spontaneous pneumothorax more frequently than women (Zhong et al., 2024). The incidence of SSP is approximately three times higher in males compared to females (Saputra, 2024). SSP is more prevalent in individuals over the age of 55 years (Huan et al., 2021). Recurrence rates within five years for SSP are higher than for primary spontaneous pneumothorax, reaching 43%, with a mortality rate of 10% (McKnight & Burns, 2025; Thanita, 2024). SSP secondary to pulmonary tuberculosis is most frequently observed in regions where tuberculosis is endemic. In Indonesia, which ranks third globally in tuberculosis cases, SSP accounts for 46.15% of all pneumothorax cases (Thanita, 2024). A study at a hospital in Semarang in 2020 found that 29% of SSP cases were caused by pulmonary tuberculosis (Siswanto, 2020).

SSP is considered a complication of pulmonary tuberculosis (Fadhilah et al., 2024). The bacteria causing tuberculosis directly invade the pleural cavity, damaging the lung parenchyma and visceral pleura (Huan et al., 2021). It may also result from a bronchopleural fistula, where the infection spreads from the interstitial tissue and bronchi to the subpleural area through the fistula (Manihuruk & Rukmana, 2023). This allows air to enter the pleural cavity, increasing intrapleural pressure to a positive level. Conversely, the pressure gradient between the alveoli and pleura decreases, reducing alveolar distensibility. This condition can lead to complications such as pulmonary atelectasis. When lung collapse occurs, the lungs become difficult to expand, resulting in elevated carbon dioxide levels in the blood and reduced oxygen levels, a condition known as hypoxemia. The body compensates by increasing respiratory muscle activity, leading to elevated respiratory rate and the sensation of dyspnea (Wentian & Wetik, 2024).

The clinical manifestations of SSP include dyspnea and pleuritic chest pain on the affected side. Dyspnea may arise suddenly during physical activity due to changes in intrapleural pressure and diminished pulmonary air reserves (Chidharla et al., 2020; McKnight & Burns, 2025). Other manifestations include decreased chest expansion during inspiration, abnormal breathing patterns, asymmetric lung expansion, hyperresonant percussion, reduced tactile fremitus, use of accessory respiratory muscles, decreased muscle strength, and reduced activity tolerance (Putri & Kaniya, 2019; Siwi, 2022).

Pulmonary tuberculosis-related pneumothorax can cause acute respiratory failure due to the accumulation of air, which increases pressure in the lungs and impairs air movement in and out during breathing (Huan et al., 2021; Imran & Eastman, 2017). Additionally, SSP carries the risk of progressing to tension pneumothorax due to increased pleural pressure, which disrupts lung and cardiac function (Chen, 2021). Impaired function can lead to decreased oxygen levels in the bloodstream, or hypoxia (Cheng et al., 2024). Therefore, immediate medical intervention is crucial, as SSP may become life-threatening (Onuki et al., 2017). Prompt and appropriate treatment can prevent further complications, improve recovery, and reduce recurrence, which is common in SSP patients (Duchman & Cheng, 2024).

Management of pneumothorax with elevated pleural pressure involves releasing the trapped air to allow lung re-expansion. This is commonly achieved by inserting a chest tube into the pleural cavity (Imran & Eastman, 2017). Conservative management, including oxygen therapy, may be provided once the patient's condition stabilizes to alleviate symptoms such as dyspnea (Sebayang & Kurniawan, 2022). Following chest tube placement, non-pharmacological interventions are necessary to address residual dyspnea, accelerate pulmonary function recovery, enhance respiratory capacity, and reduce discomfort. One such intervention is chest physiotherapy, which plays a critical role in restoring adequate respiratory function in patients with breathing disorders (Abimayu et al., 2024).

Various chest physiotherapy techniques include postural drainage, chest percussion and vibration, thoracic cage mobilization, and breathing exercises. Among these, breathing exercises are particularly suitable for independent patient practice. These exercises are easy to learn, require no equipment, are safe, and are highly effective in enhancing ventilation in pneumothorax cases. Breathing exercises include diaphragmatic breathing, active cycle of breathing techniques (ACBT), segmental breathing, and pursed-lip breathing (PLB). PLB is especially suitable during the recovery phase or following chest tube placement in pneumothorax cases (Abimayu et al., 2024). PLB improves gas exchange efficiency by prolonging the expiratory phase, thus optimizing oxygen supply. One key advantage of PLB is that it can be performed independently due to its simplicity and lack of need for assistive tools.

Pursed-lip breathing is a respiratory technique designed to enhance ventilation by inhaling through the nose and exhaling slowly through pursed lips. It aims to

slow the respiratory rate by prolonging the expiratory phase in a controlled manner, allowing breathing frequency to return to normal ranges (Isa et al., 2024). The altered inspiratory-expiratory ratio in PLB creates positive end-expiratory pressure (PEEP), preventing alveolar collapse. Keeping alveoli open enhances gas diffusion, promotes the removal of carbon dioxide, and improves oxygen intake, thereby increasing oxygen saturation (Nguyen & Duong, 2019). PLB also provides a calming effect for patients (Maind et al., 2015).

As a non-pharmacological therapy, PLB is widely used in patients with respiratory conditions and has been proven effective in numerous studies. In patients with COPD, PLB positively influences respiratory patterns (Situmorang et al., 2023). It is also effective in reducing respiratory rate in pulmonary tuberculosis patients and alleviating dyspnea in post-chest tube pneumothorax patients after being performed three times (Maulidan et al., 2025; Siokona et al., 2023).

In delivering PLB as a non-pharmacological therapy, nurses play a crucial role in patient recovery through comprehensive nursing care. Their responsibilities include assessing the respiratory system, implementing interventions to alleviate dyspnea, providing education and guidance in effective breathing techniques such as PLB, monitoring respiratory status, and offering psychological support to help patients manage anxiety related to breathing difficulties. In addition to their caregiving role, administering non-pharmacological therapy is part of nurses' autonomous functions (Wirentanus, 2019).

This case report presents a patient with *pneumothorax dextra et causa* active chronic pulmonary tuberculosis, admitted to the hospital with severe shortness of breath (Borg scale 9/10), respiratory rate of 32 breaths per minute, oxygen saturation of 74% without oxygen, heart rate of 108 bpm, blood pressure of 190/100 mmHg, and body temperature of 36.8°C. Chest radiography revealed right pneumothorax with right pleural thickening and suspected active chronic pulmonary tuberculosis, accompanied by elevated leukocyte levels. The patient underwent chest tube thoracostomy and received pharmacological treatment. However, non-pharmacological therapy was also needed to reduce persistent dyspnea. Based on the above, the aim of this case report is to examine the implementation of pursed-lip breathing in a patient with *pneumothorax dextra et causa* active chronic pulmonary tuberculosis following chest tube thoracostomy, and its impact on respiratory status.

Method

The method used in this study is descriptive in the form of a case report. A case report is a detailed observational study that presents informative medical or clinical experiences by providing patient data including demographics, clinical manifestations, vital signs, and physical examination findings relevant to the health issue. Case reports may serve as preliminary sources for further, more comprehensive research (Díaz Ibarra et al., 2023). Nursing care served as the framework in structuring this case report, beginning with assessment, data analysis, formulation of nursing diagnoses, development of nursing care plans, and implementation and evaluation of nursing interventions. The data were obtained through observation, documentation, and interviews with the patient and the patient's family. This case report adhered to ethical principles in nursing by providing the patient and family with a written informed consent form, which explained the study's purpose and procedures. The form was signed with the presence of a family member as a third party. During the informed consent process, the patient and family were allowed to ask questions and receive assurance regarding confidentiality and confirmation that the study would not cause any harm to the patient or family. The informed consent was approved voluntarily by both the patient and family, without coercion or pressure from any party.

The case involved a 70-year-old male diagnosed with right-sided pneumothorax (pneumothorax dextra) due to a ruptured bleb, suspected to result from active chronic pulmonary tuberculosis. He presented to the hospital's emergency department with a chief complaint of severe shortness of breath, rated 9 out of 10 on the Borg scale. His respiratory rate was 32 breaths per minute, oxygen saturation was 74% on room air, heart rate was 108 beats per minute, blood pressure was 190/100 mmHg, and body temperature was 36.8°C. A chest X-ray revealed a right-sided pneumothorax with suspicion of active chronic pulmonary tuberculosis. Laboratory tests showed elevated leukocyte levels of 13.91 x 10^3/µL. An emergency chest tube thoracostomy (CTT) was performed at the right second intercostal space. Following the procedure, the patient was transferred to the surgical inpatient ward but continued to complain of shortness of breath, which had been experienced intermittently for the past seven months and had worsened over the ten days prior to hospital admission. The shortness of breath occurred both during work at sea as a fisherman and during rest. The patient stated he had never sought medical attention for his symptoms and was unaware of his tuberculosis history. He also reported a smoking history of half to two packs per day for 55 years, starting at the age of 15. Additionally, the patient had a known history of hypertension for the past five years.

On the assessment conducted on September 31, 2024, the patient reported moderate dyspnea, with a Borg scale score of 3 out of 10 and grade 2 on the modified Medical Research Council (mMRC) scale. Despite the reduction in dyspnea severity, the patient still experienced difficulty eating and sleeping due to residual breathlessness. Additional symptoms included a non-productive cough, shallow breathing, retraction of the sternocleidomastoid and abdominal muscles, decreased tactile fremitus on the right side of the chest, asymmetrical lung expansion with reduced movement on the right, hyperresonance in the right lung field, and the presence of wheezing. Vital signs showed a blood pressure of 157/78 mmHg, heart rate of 62 beats per minute, respiratory rate of 26 breaths per minute, and oxygen saturation of 95% with 4 L/min nasal cannula oxygen. According to the Care Dependency Scale (CDS), the patient's level of dependency was classified as independent with a total score of 63.

Pharmacological interventions administered intravenously included *ceftriaxone (2x1), infimycin (1x1), ketorolac (3x1), ondansetron (2x1), omeprazole (2x1)*, and *methylprednisolone (2x1)*. Oral medications included *azithromycin (1x1), N-acetylcysteine (3x1), amlodipine (1x1)*, and *candesartan (1x1)*. The patient also received nebulization therapy with combivent and pulmicort every 8 hours. The non-pharmacological intervention provided was pursed-lip breathing (PLB). This intervention was given to address the patient's complaint of dyspnea. PLB also aims to improve breathing patterns, prevent air trapping, keep airways open to prevent pulmonary atelectasis, and serve as a relaxation technique. During implementation, the researcher first explained the PLB technique, followed by a demonstration, and then the patient was asked to practice it. According to the American Lung Association, PLB can be performed while sitting or in any comfortable position, with the neck and shoulders relaxed. The patient is instructed to inhale slowly through the nose (mouth closed) for a count of two, then exhale slowly through pursed lips as if blowing out a candle for a count of four. This cycle is repeated until the breathing pattern normalizes (Vatwani, 2019; ALA, 2023).

The intervention was carried out for three consecutive days, with the patient practicing PLB three times per session each day. The intervention was provided only when the patient's dyspnea was at a moderate level, oxygen saturation was no less than 90%, and the patient was not experiencing anxiety or restlessness. The intervention was withheld if the patient refused or experienced chest pain related to the chest tube placement. This intervention was temporary, serving as a non-pharmacological therapy during the patient's pulmonary rehabilitation program. It was discontinued once lung function and the patient's respiratory status were deemed adequate and had returned to normal. Although PLB offers several benefits, prolonged and continuous practice can lead to respiratory muscle fatigue, which may worsen the patient's condition. Therefore, PLB was limited to 3–5 breaths per session to prevent fatigue (Nguyen & Duong, 2019).

Evaluation was conducted daily by observing the implementation of PLB on days one through three. Respiratory rate was measured using a stopwatch, oxygen saturation was assessed with a pulse oximeter, and the level of dyspnea was determined using validated instruments. Dyspnea severity was assessed using the Modified Borg Scale and the Modified Medical Research Council (mMRC) Dyspnea Scale. The Borg scale measures perceived breathlessness in adults, ranging from 0 (no difficulty) to 10 (maximum difficulty), and is both easy to understand and accurate for assessing clinical symptoms (Pianosi et al., 2016; Mehmood et al., 2024). The mMRC scale evaluates breathlessness based on physical activity limitations and ranges from grade 0 (dyspnea only during strenuous activity) to grade 4 (dyspnea even during daily activities or rest) (Perez et al., 2015; Rajala et al., 2017; Munari et al., 2018; Widjanantie et al., 2024).

Result and Discussion

This case report demonstrated improvements in respiratory status and dyspnea following the application of pursed-lip breathing (PLB) in a patient with pneumothorax post-chest tube thoracostomy (CTT). Over the three-day intervention period, the patient's respiratory rate decreased from 25 to 21 breaths per minute, and oxygen saturation increased from 94% with oxygen support to 97% without it. Additionally, dyspnea severity decreased from a Borg score of 3 to 2 and an mMRC grade of 2 to 1.

Table 1. Outcomes of the Pursed Lip Breathing Intervention

Day	Time	Respiratory Rate	SpO_2	Oxygen	Dyspnea (Borg Scale)	Dyspnea (mMRC)
1	10:00 AM	25 breaths/min	94%	4 LPM	3	Grade 2
2	10:00 AM	22 breaths/min	96%	4 LPM	2	Grade 2
3	3:00 PM	21 breaths/min	97%	None	2	Grade 1

These results are consistent with a study by Masayuki et al. (2023), which demonstrated a reduction

in dyspnea severity from a Borg scale score of 6 (severe) to 4 (moderate) after three days of PLB therapy. The reduction in dyspnea was attributed to the slowing of the expiratory phase, which helps decrease airway narrowing (Masayuki et al., 2023). Similarly, Listyana et al. (2023) found that breathing exercises, including PLB performed two to three times daily, increased thoracic expansion and reduced the perception of breathlessness. PLB works by engaging respiratory muscles during inspiration, thereby increasing lung volume (Listyana et al., 2021).

PLB is recognized as a pulmonary rehabilitation technique that enhances inspiratory and expiratory muscle activity through slow, controlled breathing with pursed lips (Aytaç et al., 2024). The goal is to slow down exhalation, thereby maintaining positive pressure in the lungs to prevent airway and alveolar collapse (Zhang & Mehta, 2018). PLB focuses on ventilatory processes through strong, deep inhalation and prolonged, controlled exhalation. This change in exhalation duration increases intra-abdominal pressure, which pushes the diaphragm upward, decreasing thoracic volume. As thoracic volume decreases, intra-alveolar pressure rises, helping keep the airways open and facilitating easier breathing (Haryanti & Wahyudi, 2023).

Practicing PLB can reduce resting dyspnea by regulating breathing patterns and improving ventilation, which in turn increases tidal volume. Improved alveolar ventilation efficiency reduces the need for compensatory mechanisms such as increased respiratory rate. Over time, respiratory rate may gradually return to the normal range (Sakhaei et al., 2018). Regular PLB practice also enhances breath control, leading to a stable breathing frequency (Mukaram et al., 2022).

PLB has also been shown to improve oxygen saturation, even without supplemental oxygen. This is because PLB enhances gas diffusion efficiency in the alveoli by slowing expiratory airflow (Rahmadhanty, 2022). The prolonged expiratory phase reduces air trapping, expels more carbon dioxide, and maximizes oxygen intake. The resulting increase in alveolar oxygen diffusion into the capillaries boosts hemoglobin-bound oxygen, raising the partial pressure of oxygen in the blood and ultimately increasing oxygen saturation (Singh et al., 2019). Changes in the inspiratory-expiratory ratio during PLB also improve breath depth by allowing greater chest expansion (Pangestu & Sutawardana, 2025).

Furthermore, PLB can enhance patients' ability to perform daily activities by reducing dynamic hyperinflation. The prolonged expiratory phase helps reduce hyperinflation, alleviating dyspnea during physical activity. A study using the Glittre-ADL test found that PLB significantly reduced dynamic hyperinflation (de Araujo et al., 2015). It was also shown that performing PLB during high-intensity physical activity increased inspiratory capacity and oxygen saturation (Cabral et al., 2015). As a result, exercise tolerance improves, and limitations in daily activities are reduced (Maind et al., 2015).

In this case, the patient was diagnosed with secondary spontaneous pneumothorax as a complication of pulmonary tuberculosis. Infection with *Mycobacterium tuberculosis* leads to chronic inflammation, resulting in the formation of cavities filled with air and fluid in the lungs. These cavities may rupture, allowing air and fluid to enter the pleural space. Such cavities are typically located in the apical region of the lungs and are the primary source of secondary spontaneous pneumothorax in tuberculosis patients. Chronic inflammation can also lead to fibrosis in lung tissue and pleura, forming subpleural bullae that may rupture and cause pneumothorax (Bhanushali et al., 2025; Thanita, 2024).

Another risk factor for pneumothorax in this case was the patient's long-term history of smoking, having smoked actively for 55 years. This aligns with studies indicating that active smoking causes inflammation and damage to lung tissue, contributing to pneumothorax development (Willim, 2023). Cigarette smoke causes progressive lung damage; inflammatory cells such as neutrophils infiltrate the lungs and, along with epithelial cells, produce proteases that degrade lung tissue components such as elastin. Consequently, alveoli become unable to withstand high pressure and may rupture, allowing air to enter the subpleural space and form air pockets (blebs). When these blebs rupture, air escapes into the pleural cavity, causing pneumothorax (Kusmatuti & Marhana, 2015).

Among active smokers, PLB is considered effective in increasing thoracic expansion and improving pulmonary function (Olyverdi & Legumes, 2025). PLB also enhances exercise tolerance in smokers, allowing them to walk longer distances in the six-minute walk test, indicating improved functional capacity and respiratory endurance (Ariadie et al., 2020). In active smokers, PLB also reduces airway resistance, facilitating unimpeded airflow and thereby reducing the sensation of breathlessness (Olyverdi & Legumes, 2025).

In this case of secondary spontaneous pneumothorax due to pulmonary tuberculosis, where the patient had undergone chest tube thoracostomy but still experienced dyspnea, pulmonary rehabilitation was essential. Nurses play a crucial role in supporting patients through this rehabilitation process. They can implement rehabilitation programs that include PLB as

a non-pharmacological intervention that the patient can perform independently during daily activities following thoracostomy (Sakhaei et al., 2018). PLB is particularly suitable because it is safe, practical, and easy to perform.

This study has several limitations, primarily the short duration of the intervention, which does not allow for long-term evaluation of PLB's benefits. Furthermore, there is limited research focusing specifically on PLB interventions in pneumothorax cases. Therefore, the results of this case report may serve as a foundation for future studies on the effectiveness of PLB in patients with secondary spontaneous pneumothorax. Future researchers may also consider combining PLB with other interventions to enhance the evidence base for non-pharmacological therapies in pneumothorax management.

Conclusion

The application of pursed-lip breathing (PLB) in a patient with right-sided pneumothorax, secondary to a history of active pulmonary tuberculosis and chronic smoking, following chest tube thoracostomy, showed significant improvement in respiratory status. The intervention effectively increased oxygen saturation reduced respiratory rate, and alleviated dyspnea. PLB presents itself as a simple, practical, and effective non-pharmacological therapy. Healthcare providers, particularly nurses, should consider incorporating PLB as an independent nursing intervention in pulmonary rehabilitation programs for pneumothorax patients post-CTT.

Acknowledgments

The authors extend their sincere appreciation to the patient and the patient's family at the participating hospital for their cooperation and willingness to engage in the intervention as part of this study.

Author Contributions

The primary author was responsible for implementing the intervention, while all authors contributed to the drafting and development of the case report manuscript.

Funding

This research was not supported by any specific grant from public, commercial, or not-for-profit funding agencies. The interventions were conducted as part of standard clinical practice at the healthcare institution.

Conflicts of Interest

The authors declare no conflicts of interest related to this case report.

References

1. Abimayu, R. J., Perdana, S. S., & Utami, M. N. (2024). Penatalaksanaan Fisioterapi pada Penderita Pneumothorax: Case Report Study. *Academic Physiotherapy Conference Proceeding*, 260–264.
2. ALA. (2023). *Pursed Lip Breathing*. American Lung Association. https://www.lung.org/lung-health-diseases/lung-disease-lookup/copd/resource-library/pursed-lip-breathing-video
3. Ariadie, D. H., Sumardi, S., & Retnowulan, H. (2020). The Effect of Pursed-Lip Breathing on Functional Capacity of Stable Chronic Obstructive Pulmonary Disease Patient Assessed by Six Minutes Walk Test. *Acta Interna: The Journal of Internal Medicine*, *10*(1), 29–36. https://doi.org/https://doi.org/10.22146/actainterna.61297
4. Atika, K., & Rosfadilla, P. (2025). Pneumothoraks : Definisi Hingga Penatalaksanaan. *Jurnal Kesehatan Dan Kedokteran*, *2*(1), 67–82. https://doi.org/https://doi.org/10.62383/vimed.v2i1.1071
5. Aytaç, S., Ovayolu, Ö., & Dogru, S. (2024). The effect of breathing exercises on fatigue in tuberculosis patients: a randomized controlled trial. *Revista Da Associação Médica Brasileira*, *70*(12), e20240888.
6. Bhanushali, J., Ghewade, B., Jadhav, U., Wagh, P., Sarkar, S., Sindhu, A., Reddy, B. S. K., Toshniwal, A. N., kiran Reddy, B. S., & Toshniwal Jr, A. N. (2025). Tuberculosis Presenting As Spontaneous Pneumothorax: A Case Report. *Cureus*, *17*(1).
7. Cabral, L. F., D'Elia, T. D. C., Marins, D. D. S., Zin, W. A., & Guimarães, F. S. (2015). Pursed lip breathing improves exercise tolerance in COPD: a randomized crossover study. *European Journal of Physical and Rehabilitation Medicine*, *51*(1), 79–88. https://search.ebscohost.com/login.aspx?direct=true&db=mdl&AN=24691248&site=ehost-live
8. Chen, Y. (2021). Expert consensus on the emergency diagnosis and therapy of acute chest pain (English version). *Emergency and Critical Care Medicine*, *1*(2). https://journals.lww.com/eccm/fulltext/2021/12000/expert_consensus_on_the_emergency_diagnosis_and.2.aspx
9. Cheng, H.-S., Wong, C., Chiu, P.-H., Tong, C.-W., & Miu, P.-L. F. (2024). Management of

spontaneous pneumothorax: a mini-review on its latest evidence. *Journal of Thoracic Disease*, *16*(7), 4756–4763. https://doi.org/10.21037/jtd-24-415

10. Chidharla, A., Matthew, S., Marisa Ayari, A., & and Chittivelu, S. (2020). A woman with dyspnea and recurrent pneumothorax: when dyspnea is not asthma. *Journal of Community Hospital Internal Medicine Perspectives*, *10*(4), 334–337. https://doi.org/10.1080/20009666.2020.1771125
11. Costumbrado, J., & Kim, S. (2017). Spontaneous pneumothorax. *Journal of Education and Teaching in Emergency Medicine Title*, *2*(4), 22–24. https://doi.org/10.5070/M524036782
12. de Araujo, C. L. P., Karloh, M., Dos Reis, C. M., Palú, M., & Mayer, A. F. (2015). Pursed-lips breathing reduces dynamic hyperinflation induced by activities of daily living test in patients with chronic obstructive pulmonary disease: A randomized cross-over study. *Journal of Rehabilitation Medicine*, *47*(10), 957–962. https://doi.org/10.2340/16501977-2008
13. Díaz Ibarra, E. A., Abella Pinzón, J. A., & Medina, Y. F. (2023). Methodology: How to develop a case report or case series report. *Revista Colombiana de Reumatología (English Edition)*, *30*(2), 129–136. https://doi.org/https://doi.org/10.1016/j.rcreue.2021.05.012
14. Duchman, B., & Cheng, G. Z. (2024). Management of pneumothorax and persistent air leak—a narrative review. *AME Medical Journal*, *9*(1).
15. Fadhilah, D. R., Medison, I., Fitrina, D. W., & Mizarti, D. (2024). Tuberkulosis Paru Terkonfirmasi Bakteriologis dengan Komplikasi Pneumotoraks. *Jurnal Syntax Admiration*, *5*(4), 1227–1239. https://doi.org/10.46799/jsa.v5i4.1096
16. Haryanti, D., & Wahyudi, J. T. (2023). Efektifitas Pulsed Lip Breathing (Plb) Terhadap Penurunan Dyspnea Pada Pasien Penyakit Paru Obstruktif Kronis (Ppok): Literature Review. *Jurnal Inspirasi Kesehatan*, *1*(1), 56–64.
17. Huan, N.-C., Sidhu, C., & Thomas, R. (2021). Pneumothorax: Classification and Etiology. *Clinics in Chest Medicine*, *42*(4), 711–727. https://doi.org/10.1016/j.ccm.2021.08.007
18. Imran, J. B., & Eastman, A. L. (2017). Pneumothorax. *JAMA*, *318*(10), 974. https://doi.org/10.1001/jama.2017.10476
19. Isa, Z. S., Hudiyawati, D., & Haryanto, A. (2024). Evidence Based Practice Nursing: Pengaruh Pursed Lip Breathing Terhadap Saturasi Oksigen Pada Pasien Penyakit Paru Obstruktif Kronis di Instalasi Gawat Darurat RSUD Ir. Soekarno Sukoharjo. *Malahayati Nursing Journal*, *6*(8), 3078–3085.
20. Kusmatuti, Y., & Marhana, I. A. (2015). Seorang Perempuan Perokok Tembakau dan Mariyuana dengan Pneumotoraks Spontan Primer Akibat Blep Multipel yang Pecah. *Jurnal Respirasi*, *1*(2), 53–59.
21. Listyana, L. R., Sudaryanto, W. T., & Haris, A. (2021). Physiotherapy Management for Patient with Primary Spontaneous Pneumothorax Dextra: A Case Study. *Academic Physiotherapy Conference Proceeding*.
22. Maind, G., Nagarwala, R., Retharekar, S., Gondane, S., Bedekar, N., Shyam, A., & Sancheti, P. (2015). Comparison between effect of pursed lip breathing and mouth taping on dyspnoea: A cross sectional study. *International Journal of Current Research and Review*, *7*(16), 17.
23. Manihuruk, D. M., & Rukmana, S. A. (2023). Pneumothoraks ec TB Paru : Laporan Kasus. *Jurnal Ilmiah Fisioterapi*, *6*(02), 31–36.
24. Masayuki, N. P. F., Komalasari, D. R., & Utami, M. N. (2023). Penatalaksanaan Fisioterapi Pada Kasus Pneumothorax ec Ppok dengan Riwayat Tuberkulosis Paru: Studi Kasus. *Prosiding Seminar Nasional ADPI Mengabdi Untuk Negeri*, *4*(1), 29–36.
25. Maulidan, M. R., Komalasari, D. R., & Lestari, R. E. (2025). Penatalaksanaan Fisioterapi pada Kasus Pneumothorax Dextra Et Causa Riwayat Tuberkulosis Paru dengan Pemasangan Water Sealed Drainage di Ruang Infeksi Rumah Sakit Paru Ario Wirawan Salatiga: Studi Kasus. *Inovasi Kesehatan Global*, *2*(1), 111–119.
26. McKnight, C. L., & Burns, B. (2025). *Pneumothorax*. StatPearls Publishing, Treasure Island (FL). http://europepmc.org/abstract/MED/28722915
27. Mehmood, A., Abbas, R., Saeed, A., Saleem, S., Nawaz, S., & Tabassum, S. (2024). Assessment of Dyspnea in Patients with Chronic Obstructive Lung Diseases with Modified Borg Scale : Descriptive Cross-Sectional Study. *The Healer Journal of Physiotherapy and Rehabilitation Sciences*, *4*(3), 998–1005.
28. Mukaram, P., Baco, N. H., & Hutahuruk, M. (2022). Pengaruh Teknik Pursed Lip Breathing Terhadap Pola Nafas Pada Pasien Gangguan Pernafasan Di Ruang Rawat Inap RS

Bhayangkara TK. III Kota Manado. *Jurnal Kesehatan Amanah*, *6*(2), 49–56.
29. Munari, A. B., Gulart, A. A., Dos Santos, K., Venâncio, R. S., Karloh, M., & Mayer, A. F. (2018). Modified medical research council dyspnea scale in GOLD classification better reflects physical activities of daily living. *Respiratory Care*, *63*(1), 77–85.
30. Nguyen, J. D., & Duong, H. (2019). *Pursed-lip breathing*. StatPearls Publishing, Treasure Island (FL).
31. Olyverdi, R., & Legumes. (2025). The efficacy of pursed lips breathing on enhancing thoracic expansion in active smokers: A quasi-experimental study in Salimpaung District, Indonesia. *Journal of Current Health Sciences*, *5*(1 SE-Articles), 43–50. https://doi.org/10.47679/jchs.202594
32. Onuki, T., Ueda, S., Yamaoka, M., Sekiya, Y., Yamada, H., Kawakami, N., Araki, Y., Wakai, Y., Saito, K., Inagaki, M., & Matsumiya, N. (2017). Primary and Secondary Spontaneous Pneumothorax: Prevalence, Clinical Features, and In-Hospital Mortality. *Canadian Respiratory Journal*, *2017*(1), 6014967. https://doi.org/10.1155/2017/6014967
33. Pangestu, A. W., & Sutawardana, J. H. (2025). Breathe Better: The Role of Pursed Lips Breathing Therapy in Chronic Bronchitis Patients. *Jurnal Kegawatdaruratan Medis Indonesia*, *4*(1), 104–144.
34. Perez, T., Burgel, P. R., Paillasseur, J.-L., Caillaud, D., Deslée, G., Chanez, P., & Roche, N. (2015). Modified Medical Research Council scale vs Baseline Dyspnea Index to evaluate dyspnea in chronic obstructive pulmonary disease. *International Journal of Chronic Obstructive Pulmonary Disease*, 1663–1672.
35. Pianosi, P. T., Zhang, Z., Hernandez, P., & Huebner, M. (2016). Measuring Dyspnea and Perceived Exertion in Healthy Adults and with Respiratory Disease: New Pictorial Scales. *Sports Medicine - Open*, *2*(1), 17. https://doi.org/10.1186/s40798-015-0038-4
36. Putri, P. P., & Kaniya, T. D. (2019). Evaluasi Radiologis Pneumotoraks Spontan Sekunder pada Pasien dengan Tuberkulosis Paru Kasus Relaps. *Medical Profession Journal of Lampung*, *9*(2), 359–365.
37. Rahmadhanty, A. (2022). Pursed-Lip Breathing Technique in Increasing Oxygen Saturation and Decreasing Dyspnea in Patients with Chronic Obstructive Pulmonary Disease: Literature Review. *Media Keperawatan Indonesia*, *5*(3), 247–254.
38. Rajala, K., Lehto, J. T., Sutinen, E., Kautiainen, H., Myllärniemi, M., & Saarto, T. (2017). mMRC dyspnoea scale indicates impaired quality of life and increased pain in patients with idiopathic pulmonary fibrosis. *ERJ Open Research*, *3*(4). https://doi.org/10.1183/23120541.00084-2017
39. Sakhaei, S., Sadagheyani, H. E., Zinalpoor, S., Markani, A. K., & Motaarefi, H. (2018). The Impact of Pursed-lips Breathing Maneuver on Cardiac, Respiratory, and Oxygenation Parameters in COPD Patients. *Macedonian Journal of Medical Sciences*, *6*(10), 1851–1856. https://doi.org/10.3889/oamjms.2018.407
40. Saputra, Y. (2024). Faktor-Faktor Yang Mempengaruhi Lama Rawat Inap Pasien Pneumotoraks Spontan Sekunder. *Journal of Anesthesiology Tiara Bunda*, *3*(2), 10–21.
41. Sebayang, A. N., & Kurniawan, S. D. (2022). Spontaneous Pneumothorax. *SCRIPTA SCORE Scientific Medical Journal*, *4*(1), 93–97. https://doi.org/https://doi.org/10.32734/scripta.v4i1.8118
42. Singh, S., Kaushal, K., & Kaur, S. (2019). Study To Check The Immediate Effect Of Pursed Lip Breathing Exercise Versus Relaxed Diaphragmatic Exercise On Heart Rate, Blood Pressure And Oxygen Saturation In Young Adults Of College Of Physiotherapy, Adesh University. *International Journal of Scientific and Research Publications (IJSRP)*, *9*(12), 884–887. https://doi.org/https://doi.org/10.29322/IJSRP.9.12.2019.P96113
43. Siokona, A. W., Kasim, Z., & Djalil, R. H. (2023). Pengaruh Latihan Pursed Lips Breathing Terhadap Respiratory Rate Pada Pasien TB Paru Di Ruangan Anggrek RS TK II Robert Wolter Mongisidi Manado. *Jurnal Ventilator*, *1*(4), 270–283.
44. Siswanto, A. H. (2020). *Gambaran Pengetahuan Perawat Dalam Penanganan Awal Tension Pneumothorax di Rumah Sakit Umum Daerah (RSUD) Kabupaten Karanganyar*. STIKes Kusuma Husada Surakarta.
45. Situmorang, S. H., Ramadhani, Y., Situmorang, H., Wahyuni, N., Haryanti, T., & Purba, V. M. (2023). Pengaruh Pursed Lips Breathing Terhadap Pola Nafas Pasien PPOK Di Rumah Sakit Sansani Pekanbaru. *JONS: Journal of Nursing*, *1*(01), 20–25.
46. Siwi, K. (2022). Penatalaksanaan Program Terapi Fisik Dada Pada Kasus Pneumotoraks Yang Disebabkan Oleh Tuberkulosis Paru. *Jurnal Ilmiah Fisioterapi Muhammadiyah*, *1*(1), 7–

12.
47. Thanita, V. (2024). Pneumotoraks Spontan Sekunder akibat Tuberkulosis Paru. *MEDICINUS*, *37*(1), 45–48.
48. Vatwani, A. (2019). Pursed Lip Breathing Exercise to Reduce Shortness of Breath. *Archives of Physical Medicine and Rehabilitation*, *100*(1), 189–190. https://doi.org/10.1016/j.apmr.2018.05.005
49. Wentian, J. S. P., & Wetik, S. V. (2024). *Asuhan Keperawatan Pada Klien Tn. R Dengan Pneumumothorax Di Ruang Inap Irina A Atas RSUP Prof. Dr. RD Kandou Manado*. Universitas Katolik De La Salle Manado.
50. Widjanantie, S. C., Susanto, A., Alwin, W., & Ilyas, M. (2024). Correlation Between Health-Related Life Quality and Dyspnea Severity in Aged COVID-19 Survivors in Indonesia. *Journal Of The Indonesian Medical Association*, *74*(4), 190–197.
51. Willim, H. A. (2023). Secondary Spontaneous Tension Pneumothorax: A Case Report of an Uncommon Presentation of Post-Tuberculosis Sequelae. *The New Ropanasuri Journal of Surgery*, *8*(2), 7.
52. Wirentanus, L. (2019). Peran dan wewenang perawat dalam menjalankan tugasnya berdasarkan undang-undang nomor 38 tahun 2014 tentang keperawatan. *Media Keadilan: Jurnal Ilmu Hukum*, *10*(2), 148–164.
53. Zhang, W., & Mehta, A. (2018). The historical perspective on pursed lip breathing exercises and its role in pulmonary rehabilitation programs. *Medical Research Archives*, *6*(8).
54. Zhong, X., Goldacre, R., Morris, E. J. A., & Hallifax, R. J. (2024). Trends in incidence of pneumothorax in England before, during and after the COVID-19 pandemic (2017-2023): a population-based observational study. *The Lancet Regional Health. Europe*, *44*(1), 100994. https://doi.org/10.1016/j.lanepe.2024.100994