

Active Cycle of Breathing Technique for Dyspnea in a Patient with Suspected Pulmonary Tuberculosis and HIV: A Case Report

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Abstract:

Pulmonary tuberculosis complicated by human immunodeficiency virus infection may contribute to respiratory impairment, increased work of breathing, secretion retention, and dyspnea. Active Cycle of Breathing Technique (ACBT) is a non-pharmacological respiratory intervention designed to improve breathing control, lung expansion, and airway clearance. This case report evaluated short-term respiratory responses to ACBT in a patient with suspected pulmonary tuberculosis, HIV, dyspnea, and an ineffective breathing pattern. The patient presented with shortness of breath, rapid, shallow breathing, use of accessory muscles, a respiratory rate of 28 breaths/min, and peripheral oxygen saturation of 97% while receiving oxygen via a non-rebreather mask at 10 L/min. ACBT was implemented as part of nursing care, in combination with semi-Fowler's position and standard respiratory management. The intervention was performed for approximately 10–15 minutes over three consecutive days, with respiratory rate and oxygen saturation assessed before and after each session. Respiratory rate generally decreased following ACBT, with the greatest reductions observed on the third day, from 28 to 25 breaths/min and from 26 to 24 breaths/min. Oxygen saturation remained stable or increased, reaching 99% after selected sessions. The patient also demonstrated improved breathing control and reduced respiratory effort. Repeated ACBT sessions were associated with short-term improvements in respiratory rate and with maintenance or modest improvements in oxygen saturation. ACBT may represent a feasible adjunctive nursing intervention for respiratory symptom management, although larger controlled studies are required to confirm its independent and sustained effects.

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INTRODUCTION

Tuberculosis remains a major global infectious disease and continues to impose a substantial burden on health systems, particularly in countries with a high prevalence of pulmonary infection and vulnerable populations (Litvinjenko et al., 2023). Pulmonary tuberculosis primarily affects the respiratory system and may cause persistent cough, sputum production, chest discomfort, fever, weight loss, and progressive respiratory impairment (Trajman et al., 2025). Respiratory manifestations can become clinically significant when infection disrupts ventilation, increases airway secretions, and elevates the work of breathing. Patients with pulmonary involvement may subsequently develop tachypnea, dyspnea, impaired airway clearance, and changes in oxygenation (Meghji et al., 2025; Ivanova et al., 2023). Effective management requires not only disease-specific

medical treatment but also supportive strategies that maintain ventilation, facilitate secretion clearance, and reduce respiratory distress during illness (Mbanje et al., 2024).

The clinical burden of pulmonary tuberculosis becomes more complex when it occurs in individuals living with human immunodeficiency virus because immune dysfunction increases vulnerability to opportunistic infections and may worsen respiratory compromise (Sossen et al., 2025). HIV progressively impairs immune function by depleting and dysfunctioning CD4 lymphocytes, reducing the body's ability to control infectious processes (Liu et al., 2024). Pulmonary tuberculosis in this context may be accompanied by systemic weakness, nutritional deterioration, reduced functional capacity, and greater difficulty maintaining effective breathing patterns (Mave et al., 2025). Respiratory deterioration can influence important physiological parameters, including respiratory rate, oxygen saturation, pulse, blood pressure, and overall tissue oxygen delivery (Michard & Saugel, 2025; Sigg et al., 2024). Nursing assessment of these parameters is therefore essential for identifying early signs of respiratory instability and selecting appropriate interventions to support patient recovery (Langkjaer et al., 2023).

Dyspnea and ineffective breathing patterns represent important nursing problems in patients with pulmonary infection because persistent increases in respiratory effort may contribute to fatigue, discomfort, and further impairment of pulmonary function (Gao et al., 2024). Rapid and shallow breathing can limit effective alveolar ventilation and may increase the use of accessory respiratory muscles (Reis et al., 2023). Retained airway secretions may further compromise ventilation by increasing airway resistance and limiting airflow to affected lung regions (Zisi et al., 2022). Nursing management commonly includes respiratory monitoring, therapeutic positioning, oxygen administration when indicated, hydration support, collaboration in pharmacological therapy, and breathing exercises (Holland et al., 2024). Non-pharmacological respiratory interventions are particularly relevant, as they can complement medical treatment and promote patient participation in symptom management (Burge et al., 2024).

The Active Cycle of Breathing Technique is a structured respiratory intervention that has been increasingly used to improve airway clearance and breathing efficiency in patients with respiratory disorders (Zisi et al., 2022). The technique consists of breathing control, thoracic expansion exercises, and forced expiratory techniques such as huffing. Breathing control is intended to promote a relaxed respiratory pattern and reduce excessive respiratory effort, while thoracic expansion exercises encourage deeper inspiration and improve lung expansion. Forced expiration supports the movement of secretions from the peripheral toward the central airways, where they can be cleared more effectively (Jones et al., 2025). Previous clinical applications have demonstrated the potential of ACBT to improve secretion clearance, respiratory patterns, pulmonary ventilation, oxygenation, and patient comfort across several respiratory conditions (Chen et al., 2023).

Current evidence on ACBT has largely focused on chronic respiratory diseases, bronchiectasis, postoperative respiratory rehabilitation, and pulmonary conditions associated with secretion retention (Phillips et al., 2023), while evidence in patients presenting with the combined clinical context of suspected pulmonary tuberculosis, HIV, and acute dyspnea remains limited. The coexistence of infectious pulmonary involvement and HIV-related immune impairment creates a more complex clinical situation in which respiratory symptoms may be influenced by infection, secretion burden, weakness, nutritional status, and altered respiratory mechanics (Sossen et al., 2025). Limited case-based evidence is available regarding short-term changes in respiratory rate and oxygen saturation following repeated ACBT sessions in this population. This gap restricts understanding of how ACBT may function as an adjunctive nursing intervention under clinically complex conditions.

The present case provides novelty by examining the short-term respiratory response to repeated ACBT sessions within a nursing care framework for a patient with suspected pulmonary tuberculosis, HIV, dyspnea, and an ineffective breathing pattern. Respiratory rate and peripheral oxygen saturation were monitored before and after the intervention to describe immediate physiological changes across multiple sessions. A semi-Fowler position and standard respiratory care were incorporated into the clinical management because these measures reflect routine nursing practice in patients experiencing respiratory compromise (Holland et al., 2024). The case offers clinically relevant information regarding the feasibility of integrating ACBT into bedside nursing care rather than evaluating the technique in isolation from routine patient management (Jones et al., 2025).

The purpose of this study was to evaluate changes in respiratory rate, oxygen saturation, and dyspnea following the implementation of the Active Cycle of Breathing Technique in a patient with suspected pulmonary tuberculosis and HIV who presented with an ineffective breathing pattern. Clinical evaluation of this approach is important because nurses require simple, non-invasive, and reproducible interventions that can be delivered alongside pharmacological and medical management (Reis et al., 2023). Evidence describing the patient's short-term response may support clinical decision-making, strengthen evidence-based nursing practice, and provide a basis for further investigation using larger samples and more rigorous research designs (Holland et al., 2024).

METHOD

This study employed a case report design with a nursing process approach. The nursing process comprised patient assessment, data analysis, formulation of nursing diagnoses and interventions using the Indonesian Nursing Diagnosis Standard (SDKI) and Indonesian Nursing Intervention Standard (SIKI), implementation of nursing care, and evaluation using SOAP documentation. The study was conducted during the patient's hospitalization at a hospital in Jember, Indonesia, from June 30 to July 3, 2025. One patient with suspected pulmonary tuberculosis and HIV presenting with dyspnea was enrolled and received Active Cycle of Breathing Technique (ACBT) therapy. Primary data were obtained through anamnesis and clinical assessment, while secondary data were extracted from medical records. ACBT was administered according to the hospital's standard operating procedure, with respiratory rate and oxygen saturation measured using a calibrated stopwatch and pulse oximeter. Ethical approval was obtained from the Ethics Committee of the Faculty of Nursing, University of Jember, in accordance with the Declaration of Helsinki and national biomedical research guidelines. Written informed consent was obtained before data collection, with safeguards for voluntary participation, confidentiality, the right to withdraw, minimization of harm, and protection of participant dignity.

PATIENT INFORMATION

A 27-year-old man with dyspnea, suspected pulmonary tuberculosis, and HIV/AIDS (B20) was referred from a primary health center and admitted to the emergency department of a hospital in Jember, Indonesia, on June 29, 2025. He reported progressive shortness of breath, productive cough, and reduced appetite for approximately one month. Initial assessment showed a respiratory rate of 28 breaths/min, blood pressure of 90/70 mmHg, pulse rate of 118 beats/min, and oxygen saturation (SpO₂) of 97% while receiving oxygen via a non-rebreather mask at 10 L/min. Initial pharmacological management included 0.9% NaCl infusion, Santesik 1 g, and ondansetron 8 mg. Laboratory findings showed hemoglobin 10.8 g/dL, hematocrit 32.2%, erythrocyte count $4.17 \times$

10⁶/μL, mean corpuscular volume 77.2 fL, and mean corpuscular hemoglobin 25.9 pg. The patient was subsequently transferred to the inpatient ward for further management.

CLINICAL FINDINGS

The patient presented with dyspnea, a history of HIV, and suspected pulmonary tuberculosis. Initial assessment showed spontaneous breathing, blood pressure of 90/70 mmHg, pulse rate of 118 beats/min, respiratory rate of 28 breaths/min, and SpO₂ of 97% while receiving oxygen via a non-rebreather mask at 10 L/min. Respiratory examination identified a rapid, shallow breathing pattern with the use of accessory muscles. Cardiovascular findings included a regular rhythm, normal S1 and S2 heart sounds, and no additional heart sounds. Three nursing diagnoses were identified: ineffective breathing pattern (D.0005) related to the pulmonary infectious process, nutritional deficit (D.0019) associated with reduced intake, ≥10% weight loss, BMI 17.3 kg/m², and decreased muscle and subcutaneous fat mass, and self-care deficit (D.0109) related to weakness and activity intolerance requiring assistance with bathing and dressing. An ineffective breathing pattern was prioritized as the primary nursing diagnosis because of the patient's persistent dyspnea and increased respiratory rate.

THERAPEUTIC INTERVENTION

Therapeutic Intervention

Outcome criteria for the priority diagnosis of ineffective breathing pattern were established using the Indonesian Nursing Outcome Standard (SLKI). At the same time, interventions were selected in accordance with the Indonesian Nursing Intervention Standard (SIKI). The Active Cycle of Breathing Technique (ACBT) was implemented as an evidence-based nursing intervention to reduce dyspnea and improve oxygen saturation. The intervention was performed twice daily for three days, with each session lasting approximately 10–15 minutes and was conducted 140 minutes after nebulizer therapy. Respiratory rate and oxygen saturation were measured before and after each session. Prior to implementation, the patient received instruction on the purpose, benefits, and procedure of ACBT and demonstrated the ability to perform the technique correctly. The patient was also encouraged to practice brief deep-breathing exercises independently when dyspnea increased.

Results of respiratory rate and oxygen saturation measurements

The following diagram shows the results of measurements taken during the patient's treatment at one of the hospitals in Jember.

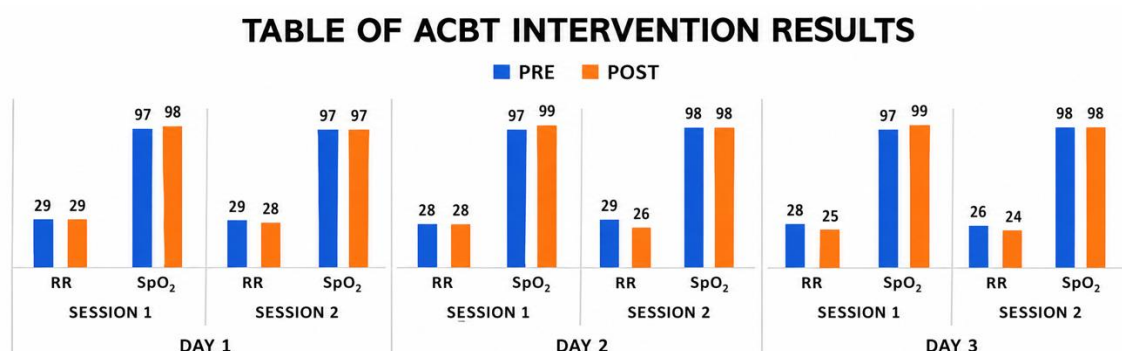


Figure 1. Results of respiratory rate and oxygen saturation measurements for 3 days before and after the intervention

The Active Cycle of Breathing Technique (ACBT) was administered for approximately 10 minutes, followed by evaluation 5 minutes later, after informed consent and explanation of the procedure, purpose, and benefits. Across three consecutive days, respiratory rate (RR) generally decreased after ACBT, while peripheral oxygen saturation (SpO₂) was maintained or improved, indicating more controlled breathing and improved oxygenation. On day 1, RR changed from 29 to 29 breaths/min with SpO₂ increasing from 97% to 98% in session 1, while session 2 showed an RR reduction from 29 to 28 breaths/min with SpO₂ remaining at 97%. On day 2, RR remained at 28 breaths/min with SpO₂ increasing from 97% to 99% in session 1, whereas session 2 showed an RR reduction from 29 to 26 breaths/min with SpO₂ remaining at 98%. On day 3, RR decreased from 28 to 25 breaths/min with SpO₂ increasing from 97% to 99% in session 1, followed by a reduction in RR from 26 to 24 breaths/min with SpO₂ remaining at 98% in session 2. These findings suggest that ACBT was associated with reduced respiratory effort, improved breathing patterns, and stable or increased oxygen saturation in this patient with suspected pulmonary TB, HIV, and dyspnea.

DISCUSSION

The present case demonstrates a clinically meaningful improvement in respiratory status following the application of the Active Cycle of Breathing Technique (ACBT) in a patient with suspected pulmonary tuberculosis, HIV, and dyspnea. The initial assessment identified an ineffective breathing pattern characterized by a respiratory rate of 28 breaths/min, shallow, rapid breathing, use of accessory muscles, and subjective shortness of breath. Oxygen saturation was 97% while the patient was receiving oxygen via a non-rebreather mask at 10 L/min. Serial observations across three days showed that respiratory rate generally decreased after ACBT sessions, whereas oxygen saturation was maintained or increased. The most prominent reductions in respiratory rate were observed during the second session of day 2, from 29 to 26 breaths/min, and during both sessions of day 3, from 28 to 25 breaths/min and from 26 to 24 breaths/min, respectively. Oxygen saturation increased from 97% to 99% during the first sessions of days 2 and 3. These changes suggest that repeated ACBT sessions were associated with progressively more controlled breathing and improved short-term respiratory parameters (Zisi et al., 2022).

The improvement observed in this case is consistent with previous research reporting beneficial effects of ACBT on respiratory function, airway clearance, and symptoms of breathlessness in patients with respiratory disorders (Lu et al., 2022). Previous studies involving respiratory conditions characterized by impaired ventilation and secretion retention have reported beneficial physiological responses following structured breathing exercises (Zisi et al., 2022). Similar findings have also been described in patients with chronic obstructive pulmonary disease, bronchiectasis, and postoperative pulmonary impairment, in whom ACBT has been used to facilitate secretion mobilization and optimize respiratory function (Phillips et al., 2026). The present findings extend these observations to a patient with suspected pulmonary tuberculosis and HIV, a clinical context in which respiratory symptoms may result from several overlapping mechanisms, including pulmonary infection, secretion retention, increased respiratory workload, systemic weakness, and compromised immune function (Sossen et al., 2025). The gradual reduction in respiratory rate across repeated sessions supports the potential usefulness of ACBT as an adjunctive intervention for controlling dyspnea in complex respiratory presentations.

The physiological effects of ACBT can be explained through the complementary actions of breathing control, thoracic expansion exercises, and the forced expiratory technique (Wilson et al., 2023). Breathing control promotes a relaxed and regulated respiratory pattern that may reduce unnecessary activation of accessory respiratory muscles and decrease the mechanical work

required for ventilation. Thoracic expansion exercises encourage deeper inspiration, increase tidal volume, and promote ventilation of lung regions that may be relatively underinflated during shallow breathing (Jones et al., 2025). Improved distribution of inspired air may enhance alveolar ventilation and contribute to more efficient gas exchange. The forced expiratory technique, commonly performed as huffing, is intended to mobilize airway secretions from smaller peripheral airways toward larger central airways and facilitate their removal (Wilson et al., 2023). The combination of these mechanisms provides a plausible physiological explanation for the reduction in respiratory rate and maintenance or improvement of oxygen saturation observed during the intervention period (Zisi et al., 2022).

The pattern of oxygen saturation observed in this case requires careful clinical interpretation because most pre-intervention values were already within a relatively high range. SpO₂ values ranged from 97% to 98% before the intervention and reached 99% after selected sessions, while several sessions showed no change. Small increases in oxygen saturation should not be interpreted as evidence of a substantial improvement in gas exchange, given that the patient was receiving supplemental oxygen via a non-rebreather mask (Thille et al., 2024). The more informative clinical response may be the concurrent reduction in respiratory rate despite relatively stable oxygen saturation, particularly during the later intervention sessions (Tredinnick-Rowe & Symonds, 2023). A reduction in breathing frequency without deterioration in oxygenation may indicate improved breathing efficiency and reduced respiratory effort. The findings are therefore more appropriately interpreted as indicating stabilization or modest improvement in oxygenation, accompanied by a clearer reduction in respiratory rate, rather than a substantial increase in oxygen saturation (Thille et al., 2024).

The progressive reduction in respiratory rate across the three-day observation period may indicate a cumulative response to repeated practice and increasing patient familiarity with the breathing technique. Early sessions produced limited changes, including an unchanged respiratory rate during the first session on day 1 and the first session on day 2. Later sessions showed larger reductions in respiratory rate, particularly on days 2 and 3. Patient adaptation may have improved the ability to coordinate breathing control, thoracic expansion, and huffing with less effort over time (Jones et al., 2025). Repeated instruction may also have increased confidence in performing the technique independently when dyspnea occurred. This pattern is clinically relevant because airway-clearance interventions depend on appropriate technique, patient engagement, education, and adherence rather than necessarily producing uniform physiological responses immediately after the first session (Herrero-Cortina et al., 2023).

The use of the semi-Fowler position may also have contributed to improved respiratory status by promoting a more upright posture and reducing positional breathlessness (Yang et al., 2026). Positioning the patient at approximately 45 degrees may facilitate respiratory comfort and support pulmonary function in individuals experiencing dyspnea. Combining ACBT with semi-Fowler positioning, therefore, represents a clinically reasonable supportive strategy for a patient with an ineffective breathing pattern (Jones et al., 2025). The intervention approach also included respiratory monitoring, supplemental oxygen, adequate fluid intake, and collaboration in bronchodilator administration. This multimodal approach is consistent with contemporary respiratory symptom management, in which breathing techniques and other supportive measures are integrated into standard medical treatment based on the patient's clinical status (Holland et al., 2024).

The findings have implications for nursing practice because ACBT is a non-invasive, equipment-free intervention that can be taught and repeated with minimal resources (Phillips et al., 2023). Nurses and other members of multidisciplinary respiratory care teams are well-positioned to assess breathing patterns, provide education on airway clearance techniques, supervise initial

practice, and monitor patient responses (Solomon et al., 2023). The technique may be particularly useful in settings where patients experience secretion retention or inefficient breathing and can actively participate in respiratory exercises (Zisi et al., 2022). Patient education is an important component because appropriate instruction and technique are central to the effective implementation and adherence to airway-clearance therapy (Solomon et al., 2023). Encouraging patients to perform the technique independently after adequate instruction may support self-management and greater participation in their own care (Franks et al., 2024). Clinical implementation should remain individualized according to the patient's respiratory status, symptoms, treatment burden, preferences, and tolerance to the intervention (Herrero-Cortina et al., 2023).

The clinical context of HIV and suspected pulmonary tuberculosis adds importance to the use of supportive non-pharmacological respiratory interventions. Pulmonary infection can increase airway secretions, impair ventilation, and stimulate a compensatory increase in respiratory rate, whereas HIV-related immune dysfunction can increase vulnerability to respiratory infections and complicate recovery (Mave et al., 2025). General weakness and poor nutritional status may further compromise functional status and contribute to adverse outcomes in patients with tuberculosis (Ockenga et al., 2023). ACBT may provide supportive benefits by improving breathing control and assisting in the mobilization of secretions (Zisi et al., 2022). The technique should not be regarded as a replacement for diagnostic evaluation, antimicrobial treatment, oxygen therapy, or other medically indicated interventions in suspected pulmonary tuberculosis or HIV-associated respiratory disease (Sossen et al., 2025). Its principal role in this context is as an adjunctive respiratory strategy to support airway clearance and manage respiratory symptoms (Zisi et al., 2022).

Several limitations restrict the interpretation and generalizability of the findings. The study involved only one patient, preventing the determination of whether the observed response would occur consistently in other patients with pulmonary tuberculosis, HIV, or different degrees of dyspnea. The absence of a comparison condition makes it impossible to distinguish the specific effect of ACBT from spontaneous clinical improvement or the effects of concurrent treatment (Taha & Abuawwad, 2025). Supplemental oxygen at 10 L/min, semi-Fowler's position, pharmacologic therapy, nebulization, bronchodilator administration, and other nursing measures were provided during the observation period and may have influenced the respiratory rate and oxygen saturation. The short three-day follow-up period limits evaluation of sustained effects on respiratory function, secretion clearance, exercise tolerance, quality of life, or recurrence of dyspnea (Phillips et al., 2023). Measurements were also restricted mainly to respiratory rate and pulse oximetry, without additional objective pulmonary outcomes such as spirometry, arterial blood gas analysis, quantified sputum production, dyspnea severity scales, or respiratory muscle assessment. Pulse oximetry should be interpreted with caution because SpO₂ may not accurately reflect arterial oxygenation in individual patients (Hess, 2024). The suspected status of pulmonary tuberculosis further limits disease-specific interpretation because the respiratory manifestations cannot be attributed definitively to confirmed tuberculosis within the information reported.

The case also highlights methodological considerations that should guide future investigations of ACBT in patients with infectious respiratory disease. More robust studies should use clearly standardized intervention frequency, duration, timing, patient positioning, and pre- and post-intervention measurement intervals (Phillips et al., 2023). Larger samples would allow assessment of variability in response by disease severity, oxygen requirement, HIV status, secretion burden, nutritional status, and baseline respiratory rate. Comparative designs help separate the independent contribution of ACBT from the effects of semi-Fowler positioning, oxygen therapy, bronchodilators, and routine medical management. Additional outcomes such as validated dyspnea scores, sputum volume, lung function, respiratory muscle workload, oxygen requirement, exercise tolerance, and

patient-reported outcomes would provide a more comprehensive assessment of clinical effectiveness. A longer follow-up would also clarify whether the short-term improvements observed during repeated ACBT sessions translate into sustained respiratory benefits and meaningful functional recovery (Phillips et al., 2026).

CONCLUSION

Active Cycle of Breathing Technique (ACBT), combined with the semi-Fowler position and standard respiratory care, was associated with improvement in respiratory status in a patient with suspected pulmonary tuberculosis, HIV, dyspnea, and an ineffective breathing pattern. Repeated ACBT sessions over three days were followed by reductions in respiratory rate and dyspnea, with maintenance or modest improvement in oxygen saturation, suggesting improved breathing efficiency and reduced respiratory effort. These findings support the potential role of ACBT as a simple, non-invasive, and feasible adjunctive nursing intervention for managing ineffective breathing patterns in patients with respiratory compromise. Interpretation should remain cautious, as the findings were derived from a single case, and concurrent interventions may have influenced the observed outcomes. Further studies with larger sample sizes, standardized protocols, control groups, and longer follow-up periods are warranted to determine the independent and sustained effects of ACBT on pulmonary function, symptom burden, secretion clearance, and quality of life.

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CONFLICT OF INTEREST

The authors report no real or perceived conflicts of interest, financial or otherwise, that could be viewed as influencing the objectivity or integrity of the research presented.

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