



Case Study

Nursing Care with Diaphragmatic Breathing Relaxation and Balloon Blowing Intervention to Improve Oxygen Saturation in Pulmonary Tuberculosis Patients

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ABSTRACT

Background: Pulmonary tuberculosis (TB) can impair lung function, resulting in ineffective breathing patterns, impaired gas exchange, and hypoxemia. Complementary nursing interventions, such as diaphragmatic breathing relaxation and balloon blowing exercises, may improve oxygenation. This case study aimed to evaluate the effectiveness of these interventions in patients with pulmonary tuberculosis.

Case Presentation: Two patients with pulmonary tuberculosis admitted to the Arofah Ward of Muhammadiyah Lamongan Hospital experienced shortness of breath, fatigue, and low oxygen saturation (91% and 92%). Nursing assessments identified ineffective breathing patterns and impaired gas exchange. Arterial blood gas analysis showed mild hypoxemia (PaO₂ 78–80 mmHg) with respiratory alkalosis due to compensatory hyperventilation.

Nursing Intervention: Patients received respiratory monitoring, oxygen therapy, and diaphragmatic breathing relaxation combined with balloon blowing exercises twice daily for three consecutive days in the semi-Fowler position.

Conclusion: Oxygen saturation improved from 91% to 96% in the first patient and from 92% to 97% in the second patient. Both patients also reported reduced dyspnea and greater breathing comfort. These findings suggest that diaphragmatic breathing relaxation combined with balloon blowing is a simple, safe, and cost-effective complementary nursing intervention that can improve oxygenation and respiratory function in patients with pulmonary tuberculosis. Further studies with larger samples are recommended to confirm these findings.

Keywords: : balloon blowing exercise, diaphragmatic breathing relaxation, oxygen saturation, Pulmonary tuberculosis

INTRODUCTION

Mycobacterium tuberculosis is transmitted through airborne droplets and primarily affects the lungs, leading to significant respiratory impairment. According to the World Health Organization [1], tuberculosis (TB) remains one of the top ten causes of death globally and the leading cause of mortality from a single infectious agent. One of the major impacts of pulmonary TB is a decrease in oxygen saturation levels, which can exacerbate clinical conditions and reduce patients' quality of life [2]. The primary problem faced by patients with pulmonary tuberculosis is respiratory dysfunction resulting from lung tissue damage, leading to ineffective gas exchange and hypoxia. This condition not only aggravates the symptoms of tuberculosis but also increases the risk of complications, thus requiring appropriate nursing interventions to improve patients' respiratory function [3].

According to the *Global Tuberculosis Report* [1], the estimated incidence of TB continues to rise, with approximately 1,060,000 new cases each year. Indonesia remains among the countries with the highest TB burden worldwide, reporting about 1,090,000 cases, including 30,000 cases of drug-resistant TB [4]. Data from Arofah Ward, Muhammadiyah Lamongan Hospital, showed that between November and December 2024, there were 43 inpatients diagnosed with pulmonary TB, with the most common nursing problems being *ineffective airway clearance* and *ineffective breathing patterns*.

Transmission of tuberculosis occurs when droplets containing *Mycobacterium tuberculosis* are released into the air through coughing or sneezing by infected individuals, particularly those with positive acid-fast bacillus (AFB) results. The bacteria may settle in the lungs and potentially spread to other organs [5]. Various strategies have been developed to improve oxygen saturation in pulmonary TB patients, including oxygen therapy and breathing exercise techniques [6]. One promising approach is the combination of diaphragmatic breathing relaxation and balloon-blowing techniques, which aim to train patients to breathe more effectively, thereby improving lung function and oxygenation [7].

The application of diaphragmatic breathing relaxation combined with balloon-blowing exercise is expected to serve as an effective, simple, and non-pharmacological intervention to enhance oxygen saturation among patients with pulmonary tuberculosis. Structured and measurable breathing exercises can improve lung capacity and stabilize blood oxygen levels [8]. Professional nursing care plays a crucial role in accelerating the improvement of oxygen saturation through the implementation of appropriate therapeutic interventions. Therefore, this case study aims to describe nursing care involving diaphragmatic breathing relaxation and balloon-blowing techniques to improve oxygen saturation in patients with pulmonary tuberculosis.

CASE PRESENTATION

Patient Information

This study involved two patients diagnosed with Pulmonary Tuberculosis who were hospitalized in the Arofah Ward of Muhammadiyah Lamongan Hospital in February 2025. The first patient, a 42-year-old male, was admitted on February 1, 2025, with the chief complaints of shortness of breath and hemoptysis characterized by fresh red blood for three days prior to hospitalization. The patient had a medical history of tuberculosis treatment for two months and hypertension since 2016. The second patient, a 38-year-

old male, was admitted on February 17, 2025, with complaints of shortness of breath that had been experienced for one week prior to admission, accompanied by productive cough with yellowish sputum for the past month. This patient was in the second week of tuberculosis treatment at the Turi Lamongan Community Health Center (*Puskesmas*).

Both patients reported no history of allergies or previous surgical procedures. However, they exhibited poor cough etiquette and inconsistent mask usage, which increased the risk of disease transmission.

Clinical Findings

Physical examination revealed that both patients were in fair general condition with full consciousness (GCS 4/5/6). The first patient had a blood pressure of 134/90 mmHg, pulse rate of 110 beats per minute, respiratory rate of 24 breaths per minute, body temperature of 36.5°C, and SpO₂ of 91% while receiving oxygen via nasal cannula at 4 L/min. The second patient presented with a blood pressure of 89/67 mmHg, pulse rate of 70 beats per minute, respiratory rate of 26 breaths per minute, body temperature of 36.8°C, and SpO₂ of 90% with nasal cannula oxygen at 6 L/min.

In the B1 (Breathing) system, both patients exhibited normochoest thoracic shape with symmetrical chest wall movement, though the breathing pattern appeared irregular. The first patient experienced productive cough with fresh blood (hemoptysis), weak vocal fremitus on the right lung, hyperresonant percussion sound, and coarse rhonchi on auscultation. The second patient produced thick, yellowish sputum typical of tuberculosis, showed weak vocal fremitus on the left lung, hyperresonant percussion tone, and bilateral rhonchi sounds.

B2 (Blood) examination showed palpable cardiac impulse at the fifth intercostal space along the left midclavicular line, regular heart rhythm, and no additional heart sounds. B3 (Brain) examination indicated full alertness without any neurological deficits. B4 (Bladder) findings revealed good genital hygiene, no catheter insertion, and adequate urine output — approximately 3000 mL in the first patient and 2800 mL in the second, both with dark orange coloration. In the B5 (Bowel) system, both patients had a flat abdomen without lesions or tenderness, and normal bowel sounds (12 times/min in the first patient and 10 times/min in the second). Both exhibited significant weight loss from 84 kg to 74 kg in the first patient and from 75 kg to 63 kg in the second, indicating nutritional decline due to chronic infection. B6 (Bone) examination showed normal muscle strength (5/5), free range of motion, and no deformities or lesions.

Psychological and social assessments revealed good interaction in both patients. The first patient perceived his illness as a test but was rarely engaged in worship during hospitalization, while the second viewed his illness as a trial and continued praying in a supine position due to physical weakness.

Laboratory results showed a leukocyte count of $5.43 \times 10^3/\mu\text{L}$ in the first patient and $11.17 \times 10^3/\mu\text{L}$ in the second. Both demonstrated elevated neutrophil levels (71.3% and 87.9%) and decreased lymphocytes (10.1% and 4.5%), indicating an active inflammatory response due to *Mycobacterium tuberculosis* infection. The neutrophil-to-lymphocyte ratio (NLR) was increased in both cases (7.1 and 19.5). Arterial blood gas analysis showed pH levels between 7.37–7.40, PaCO₂ 34–34.5 mmHg, and PaO₂ 78–80 mmHg, suggesting mild hypoxemia. Additionally, the second patient presented with hyponatremia (Na⁺ 122 mmol/L) and hypokalemia (K⁺ 2.7 mmol/L), potentially affecting respiratory muscle function.

Thoracic radiographic examinations supported the clinical findings. The first patient showed fibroinfiltrates in the right lung, upper lobe collapse, and cavitation with right-sided pneumothorax, while the second demonstrated bilateral fibroinfiltrates, left lung collapse, and left-sided pneumothorax with tracheal deviation to the right. These findings confirmed the diagnosis of pulmonary tuberculosis with pneumothorax complications.

Overall, the integration of physical, laboratory, and radiological findings indicated disturbances in gas exchange and alveolar ventilation, supporting the establishment of the nursing diagnoses Impaired Gas Exchange and Ineffective Airway Clearance

Timeline

The clinical course of the first patient began on February 1, 2025, when he presented to Muhammadiyah Lamongan Hospital with complaints of shortness of breath and hemoptysis. Following the initial nursing assessment and physical examination, the patient was placed on nasal cannula oxygen at a rate of 4 L/min to maintain adequate oxygenation. Laboratory and chest radiographic examinations revealed fibroinfiltrates in the right lung, collapse of the superior lobe, cavitation, and right-sided pneumothorax, leading to the medical diagnosis of Pulmonary Tuberculosis with pneumothorax complications. The first day of hospitalization focused on stabilizing the patient's respiratory condition, administering intravenous fluids (0.9% NaCl), and providing pharmacological therapy including Santagesik, Ranitidine, Fluimucyl, and Tranexamic Acid.

On the second and third days, close monitoring of vital signs, breathing patterns, and oxygen saturation was conducted. The initial oxygen saturation was recorded at 91%, and the patient still reported mild shortness of breath. Based on nursing assessment findings, *ineffective gas exchange* and *ineffective airway clearance* were identified as primary nursing diagnoses. Accordingly, nursing interventions consisting of Diaphragmatic Breathing Relaxation and Balloon Blowing Exercise were planned. These interventions were initiated on the fourth day of hospitalization and carried out for three consecutive days, with a frequency of five exercise sessions per day under direct nurse supervision.

The clinical course of the second patient began on February 17, 2025, with complaints of worsening shortness of breath for one week and productive cough with yellow sputum. Examinations showed bilateral fibroinfiltrates, left lung collapse, and left-sided pneumothorax with tracheal deviation to the right, along with hyponatremia and hypokalemia indicating electrolyte disturbances due to chronic infection. The patient was provided with oxygen therapy at 6 L/min and intravenous 0.9% NaCl for hydration correction. On the second day of hospitalization, after achieving hemodynamic stability, the patient began the same therapeutic interventions Diaphragmatic Breathing Relaxation and Balloon Blowing Exercise with identical duration and frequency as the first patient.

During the intervention period (days 4–6 for Patient 1 and days 2–4 for Patient 2), both patients demonstrated gradual improvement in oxygen saturation, reduction in respiratory rate, and diminished rhonchi on auscultation. By the end of the intervention sessions, oxygen saturation increased to 97% in the first patient and 98% in the second, accompanied by decreased dyspnea and improved activity tolerance. Once respiratory

conditions stabilized, both patients were deemed fit to continue tuberculosis treatment on an outpatient basis, with continuous education on breathing exercises and adherence to pharmacological therapy.

Diagnostic Assessment

A comprehensive diagnostic assessment was conducted for both patients with Pulmonary Tuberculosis to identify the underlying causes of *ineffective airway clearance*, which was characterized by the patients' inability to adequately expectorate airway secretions. The evaluation began with a systematic respiratory physical examination using a head-to-toe approach, revealing irregular breathing patterns with an increased respiratory rate (24–26 breaths per minute) accompanied by bilateral rhonchi on auscultation. These findings indicated the accumulation of secretions in the bronchial pathways due to chronic inflammatory processes, resulting in airflow obstruction.

The first patient presented with productive cough containing fresh blood (hemoptysis), whereas the second patient exhibited a productive cough with thick, yellow sputum characteristic of *Mycobacterium tuberculosis* infection. Both patients required supplemental oxygen via nasal cannula (4–6 L/min) to maintain oxygen saturation levels of approximately 90–91%, suggesting that secretion buildup hindered effective ventilation and impaired alveolar oxygen diffusion.

Chest radiographs revealed extensive fibroinfiltrates and pulmonary collapse with cavitation, accompanied by right-sided pneumothorax in the first patient and left-sided pneumothorax in the second. These radiological findings confirmed the presence of lung tissue destruction and reduced alveolar elasticity, which further compromised the effectiveness of coughing.

Hematological laboratory results demonstrated a mild increase in leukocyte count and elevated neutrophil-to-lymphocyte ratio (NLR), indicating an active inflammatory response to chronic infection. Moreover, arterial blood gas (ABG) analysis showed a decreased PaO₂ level (78–80 mmHg) and slightly reduced PaCO₂ (34–34.5 mmHg), reflecting mild hypoxemia associated with inadequate ventilation due to airway obstruction.

Based on the integration of physical, radiological, and laboratory findings, it was concluded that both patients experienced *ineffective airway clearance* caused by the accumulation of thick secretions, weakened cough reflex, and structural lung changes resulting from chronic tuberculosis. Therefore, the nursing diagnosis established was *Ineffective Airway Clearance related to increased mucus production and decreased effectiveness of the cough mechanism*.

Therapeutic Intervention

Based on the case study of both patients who presented with shortness of breath and decreased oxygen saturation, the nursing interventions were primarily focused on restoring the effectiveness of airway clearance through a multimodal approach. This approach integrated pharmacological therapy, non-pharmacological interventions, airway management, and patient health education, in accordance with the *Indonesian Nursing Intervention Standards* (PPNI, 2018).

The nursing interventions aimed to improve airway clearance by combining medical management, active breathing exercises, and patient education. Medically, both patients received an infusion of 0.9% NaCl (1500 cc/24 hours) to maintain fluid balance

and aid in secretion hydration. In addition, they were administered Santagesik (3×1 g) as an analgesic, Ranitidine (2×50 mg) to prevent gastrointestinal irritation due to stress and medications, and Fluimucil (2×600 mg) as a mucolytic agent to liquefy and facilitate sputum expectoration. Tranexamic acid (3×500 mg) was given to the first patient to manage hemoptysis, while the second patient received Ondansetron (1×8 mg as needed) to alleviate nausea associated with anti-tuberculosis medications.

The complementary therapy applied followed the study of Astriani et al. (2020), which combined *Diaphragmatic Breathing Relaxation* and *Balloon Blowing Exercise*. These were performed daily in a structured manner, with each session lasting approximately 10–15 minutes. During each session, the patient performed 10 balloon blows with a duration of 5–8 seconds per blow, followed by 30–60 seconds of rest between repetitions. This exercise referred to the *Active Breathing Exercise Standard Operating Procedure* [4], designed as a positive pressure technique to enhance secretion mobilization and expand alveolar ventilation.

The *Diaphragmatic Breathing Relaxation* was carried out by inspiring for four seconds, holding the breath for three seconds, and exhaling slowly for six seconds, repeated ten times per session in a semi-Fowler's position [7]. This procedure was guided by the principles described by Santi & Sulistiawan, tahun (2024), emphasizing the utilization of diaphragmatic muscles as a natural mechanism to increase intra-abdominal pressure and facilitate effective coughing. Throughout the sessions, nurses continuously observed patients' responses to the interventions, including breathing patterns, oxygen saturation, and coughing effectiveness.

In addition to the physical interventions, comprehensive health education was provided, covering effective coughing techniques, the importance of adequate hydration to thin secretions, postural drainage exercises, and spiritual support to enhance patient motivation. Education was delivered both verbally and through demonstration, aiming to enable patients to continue the exercises independently at home.

This integrative approach proved effective in helping patients improve airway clearance efficiency, maintain stable oxygen saturation, and reduce the frequency of dyspnea caused by secretion accumulation [11].

Follow-up and Outcomes

Throughout the intervention period, the patients' progress was closely monitored to evaluate their clinical response and overall recovery. Both patients showed gradual improvement in respiratory function and oxygenation status following the implementation of Diaphragmatic Breathing Relaxation and Balloon Blowing Exercise.

Over the course of treatment, both patients demonstrated consistent clinical improvement. The first patient, who initially presented with dyspnea and hemoptysis, showed a gradual reduction in the frequency of bloody sputum and an improved ability to expectorate. The second patient experienced a decrease in shortness of breath and reported greater comfort during rest, particularly at night.

Subjectively, both patients reported feeling relieved and able to breathe more easily after each breathing exercise session. Objectively, oxygen saturation increased from 90–91% to 95–97%, while respiratory rate decreased from 24–26 breaths per minute to 20–22 breaths per minute. Auscultation revealed diminished rhonchi sounds, indicating improved airway clearance.

These results are consistent with the physiological mechanism that diaphragmatic breathing and balloon-blowing exercises enhance alveolar expansion and facilitate secretion mobilization through increased positive airway pressure and a stronger cough reflex [12].

By the end of the intervention, both patients achieved stable oxygen saturation and demonstrated effective airway clearance with reduced respiratory distress. Psychosocially, they showed improved motivation for recovery, resumed independent participation in religious and light physical activities, and expressed confidence in continuing breathing exercises at home under nurse supervision [13].

In summary, the combination of Diaphragmatic Breathing Relaxation and Balloon Blowing Exercise effectively improved airway clearance, reduced respiratory symptoms, and optimized oxygenation in patients with Pulmonary Tuberculosis. These findings underscore the clinical value of structured active breathing exercises as a supportive intervention in respiratory nursing care

RESULTS

The results of this study present the characteristics of the patients who are the subjects in the case study. These characteristics include demographic data, clinical conditions, medical history, and other relevant information to provide a comprehensive picture of the patient's condition.

Table. 1 Demographic Characteristics of Patients Case Study

Identitas	Patient 1	Patient 2
Name	Mr. S	Mr. A
Age	55 Years	56 Years
Gender	Men - men	Men - men
Tribe	Javanese	Javanese
Religion	Islam	Islam
Education	High School/ Equivalent	High School/ Equivalent
Jobs	Farmer	Self-employed
Medical Record No.	41.xx.xx	37.xx.xx
MRS Date	12 February 2025	17 February 2025
Assessment Hours	06.39	05.46

Based on the respondent characteristics table, the two patients who were the subjects in the case study were men with almost the same age range, namely 55 years in Patient 1 (Mr. S) and 56 years in Patient 2 (Mr. A). Both are from the Javanese tribe and are Muslim. The education level of the two patients is also the same, namely high school/equivalent. The difference is seen in employment, where Patient 1 works as a farmer while Patient 2 works as a self-employed person. The assessment on Patient 1 was carried out on February 12, 2025 at 06.39 WIB, while on Patient 2 it was carried out on February 17, 2025 at 05.46 WIB. From the clinical aspect, both patients have the same medical diagnosis, namely Pulmonary Tuberculosis (TB) with pneumothorax complications. The similarity in demographic characteristics and medical diagnosis in both patients allowed researchers to compare the conditions and implementation of nursing care more focused on the health problems experienced by the patients

The implementation of nursing interventions in both patients with pulmonary tuberculosis demonstrated that combining diaphragmatic breathing relaxation with

balloon blowing exercises effectively improved oxygen saturation levels and reduced respiratory distress. Over three consecutive days of consistent intervention, oxygen saturation increased by approximately 4–5%, and the respiratory rate normalized to around 20 breaths per minute. Both patients reported decreased dyspnea and greater comfort during breathing.

These findings indicate that structured breathing exercises, when performed regularly under nursing supervision, can enhance pulmonary ventilation and facilitate sputum clearance in patients with respiratory impairment associated with tuberculosis.

Table 2. Changes in Oxygen Saturation and Respiratory Rate During Intervention

Patient	Day 1	Day 2	Day 3	Improvement
Mr. S (55 years)	SpO ₂ 91%, RR 24/min	SpO ₂ 93%, RR 22/min	SpO ₂ 96%, RR 20/min	↑ SpO ₂ +5%, ↓ RR -4/min
Mr. A (56 years)	SpO ₂ 90%, RR 25/min	SpO ₂ 93%, RR 23/min	SpO ₂ 95%, RR 20/min	↑ SpO ₂ +5%, ↓ RR -5/min

Note: SpO₂ = oxygen saturation; RR = respiratory rate.

This study supports that the combination of diaphragmatic breathing relaxation and balloon blowing exercise serves as an effective complementary nursing intervention to improve respiratory function, particularly among patients with pulmonary tuberculosis [14]. Both techniques are non-invasive, low-cost, and easily taught and implemented in both hospital and community settings [15].

From a nursing practice perspective, these findings emphasize the critical role of nurses in systematically assessing and monitoring oxygenation status, guiding patients in structured breathing exercises to improve lung capacity, and providing education and motivation to enhance adherence to therapy [16].

Through the application of these interventions, nurses not only contribute to improving pulmonary function and oxygen saturation but also play an essential role in preventing complications and enhancing the overall quality of life for patients with chronic respiratory disorders.

DISCUSSION

The nursing implementation for both patients was conducted over two intervention periods, from February 12–14 and February 17–19, 2025, in accordance with the planned nursing care interventions. The primary intervention applied was a non-pharmacological technique aimed at improving oxygen saturation, namely Diaphragmatic Breathing Relaxation combined with Balloon Blowing Exercise. This intervention corresponded to the nursing diagnosis of Ineffective Airway Clearance and referred to the Indonesian Nursing Intervention Standards (SIKI), specifically under Airway Management (PPNI, 2018).

The implementation results demonstrated a significant improvement in oxygen saturation in both patients. In the first patient, oxygen saturation increased from 93% (mild hypoxia) to 97% (within normal range) after three consecutive days of therapy, accompanied by reduced shortness of breath. Similarly, in the second patient, oxygen saturation rose from 90% to 98% after three days of nursing intervention. This improvement indicates that structured breathing exercises can enhance pulmonary ventilation and optimize gas exchange in patients with pulmonary tuberculosis.

These findings are consistent with the study of (17), which explained that diaphragmatic breathing relaxation combined with balloon blowing helps stretch the lungs, reduce alveolar surface tension, and increase vital lung capacity. The increase in vital capacity contributes to more efficient oxygen diffusion across the alveolar membrane, thereby improving oxygen binding to hemoglobin in arterial blood [18].

Furthermore, emphasized that balloon blowing exercises play an essential role in improving the lungs' ability to perform optimal ventilation by facilitating the removal of trapped carbon dioxide during exhalation and enhancing oxygen absorption during inhalation [10], [19].

Similarly, Sumaiyah, (2023) found that combining Diaphragmatic Breathing Relaxation and Balloon Blowing Exercise significantly increased oxygen saturation among patients with pulmonary tuberculosis. The physiological mechanisms underlying these outcomes include improved alveolar ventilation, increased respiratory muscle strength and endurance, and enhanced thoracic flexibility all of which collectively contribute to greater lung capacity and more efficient gas exchange [14].

From a nursing practice perspective, these findings reinforce the critical role of nurses in implementing evidence-based practices to improve patients' respiratory function [21], [22]. Nurses are responsible for systematically assessing and monitoring oxygenation status, guiding patients in structured breathing exercises, and providing education and motivation to enhance adherence to therapy [23]. However, several challenges were noted during implementation, including patient fatigue during exercises, limited motivation, and inadequate understanding of breathing techniques. Therefore, the application of therapeutic communication, adjustment of exercise rhythm, and consistent supervision are essential components for ensuring the success of this intervention [24].

Scientifically, the findings of this case study contribute to the development of nursing knowledge, particularly in the fields of medical-surgical and respiratory nursing. The results strengthen the evidence that simple, non-invasive, and low-cost interventions such as Diaphragmatic Breathing Relaxation and Balloon Blowing Exercise can serve as effective complementary therapies to improve lung function, prevent complications, and enhance the quality of life of patients with chronic respiratory disorders, particularly those with pulmonary tuberculosis

CONCLUSION

The nursing implementation for two patients with pulmonary tuberculosis was carried out over three consecutive days using non-pharmacological interventions consisting of Diaphragmatic Breathing Relaxation and Balloon Blowing Exercise. Both patients demonstrated marked improvement in oxygenation status, as oxygen saturation increased from mild hypoxia to normal levels, accompanied by reduced dyspnea and enhanced breathing comfort.

The combination of diaphragmatic breathing and balloon blowing exercises proved effective in strengthening respiratory muscles, increasing lung expansion, and improving alveolar ventilation. These outcomes align with previous studies indicating that relaxation and breathing exercises can enhance vital lung capacity and oxygen exchange efficiency.

Practically, these findings highlight the essential role of nurses in optimizing complementary therapies that are safe, simple, and cost-effective. Through patient education and guided supervision, nurses can enhance patient adherence to breathing exercises, improve pulmonary function, and ultimately enhance the quality of life of individuals with pulmonary tuberculosis. Furthermore, this study contributes to the advancement of nursing science, particularly in the application of complementary therapies to support the management of patients with chronic respiratory disorders. The government should consider incorporating diaphragmatic breathing relaxation and balloon blowing exercises into tuberculosis care programs while strengthening nurse training and patient education to improve respiratory outcomes

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Conflict of Interest

The authors declare no conflicts of interest.

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