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Pursed Lips Breathing with Balloon Enhancing Airway Clearance in Children with Pneumonia

Musviro[1], Arini Fitria[1], Nurul Hayati[1], Laili Nur Azizah[1], Anggia Astuti[1]

[1] *Faculty of Nursing, Universitas Jember, Indonesia*

Correspondence should be addressed to:
Musviro
musviro@unej.ac.id

Abstract:
Pneumonia can pose a serious threat to children's health. In pneumonia, increased lung secretions obstruct the airways, affecting breathing, especially in children who cannot expel sputum alone. If not treated immediately, this condition can be fatal. This study aimed to provide nursing care for children with nursing problems of ineffective airway clearance with Pursed Lips. Breathing using balloons can help improve gas exchange, which is observed by increasing oxygen saturation in the body and can help expel secretions. Participants in this study were pneumonia patients aged 3-5 years who were treated in the Bougenville Room of Dr. Haryoto Hospital, Lumajang, with nursing problems of Ineffective Airway Clearance and were not allergic to balloons. Data collection used interviews, observations, and documentation studies. The results of the assessment showed that An. A male, 5 years old, has a weak general condition, ineffective cough, sputum, additional breathing sounds of rhonchi, and an increased respiratory rate. The nursing problem that occurred was ineffective airway clearance. The interventions carried out refer to the Indonesian Nursing Intervention Standards (SIKI) intervention, namely airway management, respiratory monitoring, and Pursed Lips Breathing (PLB) actions. To attract children's interest, PLB uses balloons conceptualized as balloon play therapy, whose mechanism is similar to PLB with an atraumatic care approach. After nursing care for 4 days, the goals were achieved. Namely, changes in effective coughing increased, sputum decreased, additional breath sounds were absent, breathing patterns changed, and breathing frequency improved. Pursed Lips Breathing (PLB) can increase alveolar expansion in each lung lobe so that alveolar pressure increases and secretions can be pushed into the airway during expiration. PLB can be carried out to increase knowledge as an innovative intervention in treating children with pneumonia diagnosed with ineffective airway clearance.

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INTRODUCTION

Pneumonia remains a leading cause of pediatric morbidity and mortality worldwide, particularly in low- and middle-income countries such as Indonesia (Berger et al., 2022). As an acute respiratory infection characterized by inflammation of the alveoli and interstitial lung tissue, pneumonia is primarily caused by bacterial, viral, or fungal pathogens, including Streptococcus pneumoniae, Haemophilus influenzae type b (Hib), and Respiratory Syncytial Virus (RSV) (Calderaro et al., 2022). These pathogens trigger inflammatory responses, leading to alveolar exudation, impaired gas exchange, and excessive mucus production. Despite advancements in medical care, pneumonia accounts for a significant proportion of deaths among children under five years globally,

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underscoring its persistent public health impact. Effective management strategies are critical to mitigate complications arising from airway obstruction and respiratory failure (Moon et al., 2025).

In children, pneumonia often results in airway obstruction due to infection-induced edema, increased mucus secretion, and compromised mucociliary clearance (Youssef et al., 2024). The body's compensatory mechanism involves hypersecretion of viscous phlegm to trap pathogens, yet this exacerbates airway blockage. Children aged 3–5 years frequently lack the strength and coordination to perform effective coughing, leading to retained secretions (Cherchi et al., 2021). This creates a vicious cycle of inflammation, hypoxemia, and reduced lung compliance. Prolonged airway occlusion can progress to severe hypoxia, systemic complications, and even death, necessitating timely interventions to restore airway patency and oxygenation (Berkow, 2024).

A combination of intrinsic and extrinsic factors influences the susceptibility to pneumonia in children. Intrinsic risks include age, low birth weight (LBW), malnutrition, vitamin A deficiency, and inadequate immunization status (Deranita & Sahrudi, 2024). Extrinsic factors encompass environmental exposures such as indoor air pollution, poor ventilation, household crowding, and parental smoking (Qu et al., 2023). Cigarette smoke, both active and passive, significantly weakens respiratory immunity, increasing vulnerability to infections. Maternal factors compound the risk, including limited health literacy and socioeconomic constraints. Addressing these multifactorial determinants is essential for preventing disease progression and improving outcomes (Zhao, 2024).

Adequate airway clearance is a cornerstone of pneumonia management, particularly in pediatric populations (Rolek, 2024). Accumulated secretions impair ventilation-perfusion matching, predisposing children to atelectasis, secondary infections, and respiratory distress. Pharmacological therapies, such as antibiotics and bronchodilators, target the underlying infection but do not directly address secretion removal (Alam et al., 2024). Non-pharmacological interventions, including chest physiotherapy and breathing exercises, support respiratory function. Prioritizing airway hygiene through structured interventions can reduce hospitalization duration, alleviate symptoms, and prevent life-threatening complications (Reis et al., 2022).

Non-pharmacological approaches are increasingly recognized as adjunctive therapies in pediatric respiratory care. Postural drainage-assisted coughing and incentive spirometry enhance secretion mobilization and lung expansion (Tahir et al., 2021). Pursed lip breathing (PLB) has demonstrated efficacy in adult populations by promoting prolonged exhalation, stabilizing airway pressure, and preventing alveolar collapse (Andrian & Rosyid, 2024). However, its application in children remains underexplored. Adapting PLB for pediatric use requires developmentally appropriate strategies to ensure engagement and adherence, particularly in resource-limited settings where advanced medical equipment may be unavailable (Huang et al., 2024).

PLB involves slow nasal inhalation followed by controlled exhalation through pursed lips, creating positive end-expiratory pressure (PEEP) that maintains airway patency and facilitates secretion clearance (Alqadi et al., 2025). In children, this technique can be gamified to align with developmental needs. For instance, blowing a balloon or creating bubbles through a straw mimics the mechanics of PLB while engaging motor and sensory skills. These playful adaptations increase expiratory effort, alveolar recruitment, and secretion mobilization, making them particularly suitable for young patients who struggle with conventional breathing exercises (Yang et al., 2020).

Integrating balloon-blowing into PLB therapy represents a novel, cost-effective strategy to enhance airway clearance in children with pneumonia. By prolonging exhalation and augmenting intrathoracic pressure, balloon exercises replicate the physiological benefits of PLB while fostering patient cooperation. This method reduces anxiety associated with medical procedures and transforms therapeutic exercises into enjoyable activities (Rosuliana et al., 2024; Setyowinarni, 2023). Preliminary evidence suggests that such playful interventions improve treatment adherence

Volume 03 Number 03
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and clinical outcomes. Further research is warranted to validate its efficacy, standardize implementation protocols, and evaluate scalability within diverse healthcare systems. This approach holds promise as a sustainable, child-friendly intervention to address the global burden of pediatric pneumonia.

STUDY DESIGN

Study Setting and Timeline

Data was collected from May 18 to May 21, 2023, at the Boughenville Room of Dr. Haryoto Regional Hospital, Lumajang, Indonesia. This period was selected to ensure adequate patient enrollment while minimizing disruptions to routine clinical operations. The secondary-level healthcare facility serves a high volume of pediatric pneumonia cases, making it an appropriate setting for studying airway clearance interventions in children. The study focused on pediatric patients aged 3–5 years diagnosed with pneumonia and presenting with ineffective airway clearance, as documented in their medical records.

Data Collection Procedures

Data collection followed a multi-method approach, integrating medical record reviews, direct interviews, and document analysis. Initial screening of diagnoses was performed using electronic health records to identify eligible participants based on inclusion criteria (e.g., confirmed pneumonia diagnosis, age range, and presence of ineffective airway clearance). Subsequently, structured interviews were conducted with patients and their caregivers to gather qualitative insights into challenges related to secretion management, family caregiving practices, and adherence to therapeutic interventions. Additionally, document analysis focused on reviewing nursing care plans, physician notes, and treatment logs to extract quantitative data on clinical outcomes and intervention implementation.

Ethical Considerations

The study received ethical clearance from the Health Research Ethics Committee of the Faculty of Nursing, University of Jember (Ethical Number: 090/UN25.1.14/KEPK/2023), ensuring compliance with international standards for human subject research. Prior to data collection, informed consent was obtained from all participating caregivers, and assent was sought from children aged 5 years. Confidentiality was maintained by anonymizing patient identifiers in all records and transcripts. All procedures adhered to the principles of the Declaration of Helsinki, prioritizing participant safety, voluntary participation, and data integrity.

CLINICAL FINDINGS

The results of the nursing assessment showed that patient A, a 5-year-old and 10-day-old boy, was diagnosed with pneumonia. The family reported that the child had a "gurgling" cough. The data from SDKI (Standard Nursing Diagnosis of Indonesia) identified ineffective cough, inability to cough, excessive sputum, and additional rhonchi breath sounds. The nursing diagnosis determined from the assessment and the subjective and objective data collected was ineffective airway clearance.

The defining characteristics that appeared in the patient with ineffective airway clearance were the following significant signs and symptoms: ineffective or inability to cough, excessive sputum, the presence of additional rhonchi breath sounds, increased respiratory rate (RR 36x /minute, and altered breathing patterns. The nursing interventions selected by the writer included airway

Volume 03 Number 03
June 2025
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management and respiratory monitoring—the airway management intervention aimed at identifying and maintaining airway patency. In addition, the writer performed pursed-lip breathing (PLB) to help expand the alveoli in the lung lobes, promote secretion clearance from the airways, and increase alveolar pressure during exhalation.

On the first day after initiating PLB and performing respiratory monitoring, the results were: pulse 125x/minute, SpO_2 96%, RR 35 x/minute. On the second day, respiratory monitoring showed a pulse of 120 bpm, SpO_2 98%, and RR of 34 bpm. On the fourth day, marking the completion of the intervention, respiratory monitoring results were: pulse 116 bpm, SpO_2 98%, RR 28 bpm. The success of the intervention was evident from the evaluation results, showing that the goals set by the writer were gradually achieved from the first to the fourth day: the effectiveness of coughing improved, respiratory rate decreased to 28 x/minute, breathing patterns improved, and the additional breath sounds (rhonchi) reduced.

DISCUSSION

In this case, the patient is a 5-year-old boy accompanied by his 31-year-old mother. Pneumonia most commonly affects children aged 1 to 5 years and can occur in both boys and girls. However, boys are generally more susceptible to lower respiratory tract infections. Anatomically, boys tend to have narrower airways than girls, increasing their risk of developing respiratory diseases and experiencing wheezing more frequently (Perret et al., 2021).

The history of the disease is that the client has a cough with green phlegm, fever, and additional breath sounds (rhonchi). The signs experienced by the child are high fever, cough accompanied by phlegm, shortness of breath, and loss of appetite. Based on the previous medical history, the client does not have a history of pneumonia, but the client's family is active smokers. Cigarette smoke increases the risk of disease spreading. It can lower immunity, which can threaten the immune system and affect all smokers, both active and passive, especially in children, because they are more susceptible to disease. Based on the immunization history, complete client data were obtained. Immunization is one way to provide someone with active immunity against infectious diseases. Children with weak immune systems are at greater risk of pneumonia due to incomplete basic immunization (Sutriana et al., 2021).

The client was born spontaneously, with a birth weight of 2700 grams, and did not experience asphyxia or other ARI. The causative factor of pneumonia related to the history of pregnancy and childbirth is premature rupture of membranes at the client's birth, placing the client at risk of meconium aspiration, which causes shortness of breath. Postpartum ARI can also be a cause of bronchial pneumonia. Problems in low birth weight (LBW) babies, especially premature babies, arise due to the immaturity of the baby's organ systems. The client has been breastfeeding for 2 years and an additional 6 months. Risk factors for pneumonia include malnutrition, low birth weight, non-exclusive breastfeeding, indoor air pollution, house crowding, parents who smoke, air humidity, and cold air. A history of exclusive breastfeeding has a significant effect on the incidence of toddler pneumonia. Toddlers who do not receive exclusive breastfeeding are at risk of developing pneumonia 4.47 times higher than toddlers who receive exclusive breastfeeding. Antibodies in breast milk, such as SIgA and IgG, play a significant role in maintaining the integrity of the respiratory tract mucosa (Kang et al., 2024).

During the physical examination, the patient's physical structure was heard to have additional breathing sounds, as seen in the rhonchi lung auscultation examination. It can be assumed that the rhonchi sound heard during lung auscultation examination is caused by the accumulation of secretions. The mucus that arises is an immune response when viruses and bacteria attack the

body. In addition, children with respiratory pneumonia use accessory respiratory muscles in moderate to severe pneumonia. Depending on the examination, the patient's leukocyte count is normal or even low (Li et al., 2023). Since the onset of pneumonia, the patient's examination was carried out on May 18 at 03.08 WIB, and the body's initial response was characterized by releasing excessive amounts of leukocytes. However, the client's Hb decreased due to the inflammatory process.

Upon examination of the client's chest X-ray, there were infiltrated spots in the right and left lobes. Examination of the chest X-ray in patients with pneumonia shows infiltrate spots if, in lobar pneumonia, there is consolidation in one or more lobes. Pneumonia bacteria can be a source of chest X-ray findings such as infiltrates, consolidation, pleural effusion, bronchopneumonia, and air bronchogram if accompanied by symptoms such as high fever, chills, cough, and shortness of breath (Gül et al., 2022).

The data that appears in patients is a cough that cannot be expelled by itself, which supports the diagnosis of ineffective airway clearance. This patient has difficulty coughing effectively, which can cause a buildup of secretions in the airways, affecting the body's ability to clear the airways effectively. This buildup of secretions can block airflow and cause symptoms such as rhonchi, which are gurgling breath sounds (Singh, 2023; Fedora et al., 2024).

Nursing interventions for ineffective airway clearance nursing problems are primary interventions with airway management, supporting interventions with respiration monitoring, and additional interventions, namely pursed lip breathing (PLB) therapy using a balloon. The planned nursing interventions carry out the implementation of nursing care (Gaspar et al., 2024). By what has been planned on the first day of the implementation of the primary intervention carried out by the author was to carry out observation actions, namely monitoring breathing patterns (frequency, depth, breathing effort) and carrying out Pursed Lips Breathing therapy using a balloon which is carried out 1x a day repeated 3-4x for 10 minutes and monitoring additional breath sounds, then carrying out therapeutic actions. Actions consisting of positioning semi-fowler. Furthermore, on the first day, the author carried out observation actions, monitoring the ability to cough effectively and the presence of sputum. In therapeutic actions, monitoring respiration before and after the Pursed Lips Breathing (PLB) intervention was carried out. Moreover, the author carried out educational actions to monitor respiration.

On the second day of implementation, there were changes and additions to therapeutic actions, namely, giving warm drinks to children. Pursed Lips Breathing (PLB) therapy using a balloon was carried out until the balloon was inflated. It was carried out once a day, repeated 3-4 times for 10 minutes. On the third day, the author carried out observation actions, namely monitoring breathing patterns (frequency, depth, breathing effort) and carrying out Pursed Lips Breathing therapy using a balloon, which was carried out once a day, repeated 3-4 times for 10 minutes and monitoring additional breath sounds, then carrying out therapeutic actions. Actions consisting of positioning semi-fowler. Furthermore, on the first day, the author carried out observation actions, monitoring the ability to cough effectively and the presence of sputum. In therapeutic actions, monitoring respiration before and after the Pursed Lips Breathing (PLB) intervention was carried out. In addition to educational actions, the author carried out educational actions to monitor respiration. On day 3, there were changes after the additional intervention of Pursed Lips Breathing Therapy was carried out, namely, additional breathing decreased, effective coughing, reduced sputum, and the patient's RR improved (Riyanti & Nursasmita, 2025).

On the fourth day, the author conducted observation actions, namely monitoring breathing patterns (frequency, depth, breathing effort) and conducting Pursed Lips Breathing therapy using a balloon, which was done once a day, repeated 3-4 times for 10 minutes, and monitoring additional

Volume 03 Number 03
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breath sounds, then conducting therapeutic actions. Actions consisting of positioning a semi-fowler. Furthermore, on the first day, the author conducted observation actions, monitoring the ability to cough effectively and the presence of sputum. In therapeutic actions, respiration monitoring was conducted before and after the Pursed Lips Breathing (PLB) intervention. In addition to educational actions, the author conducted educational actions to monitor respiration. This is the last implementation because the objectives have been achieved, and the problems have been resolved (Sari & Qudrotillah, 2025).

Nursing evaluation conducted until the fourth day of client evaluation has achieved the objectives planned by the author, starting gradually from the first day to the fourth day, namely, the effective form increased, the respiratory rate decreased (28 x / minute), the breathing pattern improved, and additional breath sounds decreased. In addition, PLB intervention was carried out; some changes could be seen on the third day, where the cough began to decrease, additional breath sounds were gone, sputum decreased, and A's respiratory rate, pulse, and oxygen saturation were within the normal range. Referring to the priority of PLB actions, using balloons until the balloon expands and is carried out 1x a day with 3- 4 repetitions for 10 minutes for 4 days. Nursing evaluation after 4 days of implementation, the objectives were achieved with the criteria for effective coughing results increasing, sputum production decreasing, rhonchi decreasing, and respiratory rate decreasing.

This approach helps reduce the anxiety and fear that children often experience during hospitalization, especially during respiratory procedures. Hospitalization can be a traumatic experience for children because of the various unfamiliar and often invasive procedures (Ramgopal et al., 2022). Therapy becomes more interesting and less frightening by involving balloons, which are familiar and fun objects for children. This strategy increases children's cooperation during the intervention and supports children's emotional well-being, which can ultimately reduce the long-term psychological impact of hospitalization. Involving children in interactive therapy activities like this can increase their self-confidence and involvement in self-care, an important aspect of pediatric nursing. The play element in balloon exercises also encourages children to practice more often and increase adherence to therapy, which can accelerate the healing process and improve overall treatment outcomes. Thus, PLB using balloons can be seen as a holistic intervention that considers pediatric patients' physical and psychological needs, which aligns with the principles of family-centered care and atraumatic care in pediatric nursing practice.

CONCLUSION

The problem of ineffective airway clearance refers to the Indonesian Nursing Intervention Standards (SIKI), namely airway management and respiration monitoring. Pursed Lips Breathing (PLB) actions with balloons are essential to attract children's interest, with balloon-blowing activities whose mechanism is similar to PLB, using an atraumatic care approach that can be done on pediatric patients. Nursing care is implemented through the author's planned nursing interventions, Pursed Lips Breathing (PLB) Therapy. Referring to the priority of PLB actions, using balloons until the balloon expands and is carried out 1x a day with 3- 4 repetitions for 10 minutes for 4 days. Nursing evaluation after 4 days of implementation, the objectives were achieved with the criteria for effective coughing results increasing, sputum production decreasing, rhonchi decreasing, and respiratory rate decreasing. Pursed Lips Breathing (PLB) can increase alveolar expansion in each lung lobe so that alveolar pressure increases and secretions can be pushed into the airway during expiration.

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Volume 03 Number 03
June 2025
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