Original Article
Comprehensive expectoration nursing in elderly patients with pulmonary infection and its influence on respiratory function

Xiaofang Wu[1], He Zhang[2], Jiayi Chen[1]

[1]Geriatric and General Medicine Department, Nantong First People's Hospital, Nantong 226001, Jiangsu Province, China; [2]Radiological Department, The First Affiliated Hospital of China Medical University, Shenyang 110000, Liaoning Province, China

Abstract: Objective: To investigate the effect of comprehensive expectoration nursing in elderly patients with pulmonary infection and its influence on respiratory function. Methods: Clinical data of 88 elderly patients with pulmonary infection treated in our hospital from March 2018 to May 2020 were analyzed retrospectively. During treatment, 40 patients receiving conventional nursing mode were included in the control group (CG), and 48 with comprehensive expectoration nursing were included in the observation group (OG). The number of patients with spontaneous expectoration, assisted expectoration and sputum aspiration one week after nursing, the related indices of blood oxygen and lung function before and after nursing, and the sputum excretion volume, respiratory rate and neutrophils one week after nursing, were compared between the two groups. The hospitalization time, expenses, patients' quality of life after nursing and nursing satisfaction were also compared between the two groups. Results: Compared with the CG, the hospitalization time and expenses of patients in OG were obviously lower, while the effective rate of sputum excretion was obviously higher after nursing. The blood oxygen, lung function, sputum excretion volume, respiratory rate and neutrophil recovery in OG were obviously better than those in CG. Meanwhile, compared with the CG, the quality of life and nursing satisfaction of patients in OG were obviously higher after nursing. Conclusion: Comprehensive expectoration nursing in elderly patients with pulmonary infection has better effect and is able to effectively improve their respiratory function, quality of life and nursing satisfaction.

Keywords: Comprehensive expectoration nursing, elderly patients with pulmonary infection, lung function, respiratory function

Introduction

Pulmonary infection is a pervasive disease of the elderly, which is mainly due to the gradual degeneration in the body function [1]. Pulmonary infection ranks third among all causes of death, of which, more than 50% of the patients over 60 years old die from pulmonary infection [2]. The number of elderly patients has been increasing and invasive operation and chronic obstructive pulmonary disease are vital factors affecting pulmonary infection in the elderly [3]. Poor lung infection in the elderly may be attributed to their declined cellular immune function and the respiratory mucosa's defense under the condition of a variety of chronic diseases [4, 5]. Related studies have

revealed that lung infection is one of the main causes of death in the elderly [6]. This is mainly because the aged patients with pulmonary infection can't discharge sputum autonomously because of decline in swallowing function, which may lead to asphyxia or even respiratory failure, endangering their lives [7]. Therefore, it is crucial to take effective nursing measures and remove airway secretion for improving patients' symptoms.

In recent years, comprehensive expectoration nursing has been widely used in respiratory diseases, which mainly refers to helping patients clear airway obstruction through standardized methods [8]. Previously, many scholars have studied comprehensive expectoration

nursing. For example, some studies [9] have revealed that comprehensive expectoration nursing in elderly patients with bronchial asthma can effectively ameliorate the airway obstruction of patients. While other studies [10] have uncovered that comprehensive expectoration nursing has a significant effect on resolving sputum and relieving asthma, promoting sputum elimination and relieving illness in patients with pneumoconiosis complicated with pulmonary infection. However, there are relatively few researches on the application of comprehensive expectoration nursing in patients with pulmonary infection at present. Some studies [11, 12] only showed that expectoration related nursing measures treated for patients with pulmonary infection achieved good therapeutic effect.

In this study, we investigated the effect of comprehensive expectoration nursing in elderly patients with pulmonary infection and such nursing mode can improve patients' respiratory function and effectively improve their quality of life.

Materials and methods

Clinical data

Clinical data of 88 elderly patients with pulmonary infection in our hospital from March 2018 to May 2020 were analyzed retrospectively. There were 47 male and 41 female patients, with an average age of (71.45±5.22) years old. During treatment, 40 patients receiving conventional nursing mode were included in the control group (CG), and 48 underwent comprehensive expectoration nursing were included in observation group (OG).

Inclusion criteria: Patients diagnosed with pulmonary infection [13]; Patients with age over 60 years old; Patients with complete clinical data.

Exclusion criteria: Patients with severe cardiopulmonary or other severe organ diseases; Patients with consciousness or communication disorder; Patients with upper airway obstruction; Patients complicated with malignancies; and patients transferred to other hospital during the treatment.

This test has been ratified by the hospital ethics committee (Ethics batch No.: 2020 (Trial) 102 (batch)), which is also conformed to the Declaration of Helsinki.

Materials and instruments

Care Fusion pulmonary function instrument (Germany, Younger Development), blood gas analyzer G-100 (China, Shenzhen Siemantec Technology), mask atomizer (China, Welllead), levofloxacin hydrochloride (China, Yangtze River Pharmaceutical Group, SFDA approval No. H20060026), ambroxol hydrochloride injection (China, Boehringer Ingelheim, SFDA approval No. J20080083).

Treatment plans

At admission, levofloxacin hydrochloride (0.6 g intravenous drip) combined with ambroxol hydrochloride injection (30 mg + 100 mL normal saline intravenous drip) was initially given twice a day for 7 days.

Nursing methods

In CG, patients received the routine nursing mode. The nursing staff monitored the vital signs of patients and guided them to take expectorant and anti-infective drugs as recommended; the patients could relieve the symptoms by inhaling oxygen or improving the body resistance; the staff also provided a suitable and clean environment for patients.

In OG, patients received comprehensive expectoration nursing mode: (1) Health knowledge education: The nursing staff explained the operation methods, precautions and expected effects of sputum excretion apparatus and atomization inhalation treatment to patients with enthusiasm and patience, and obtained the consent and cooperation of patients and their families. (2) Psychological nursing: The nurses patiently and timely communicated with patients and their families, grasped the psychological state of patients at any time, and fully understood the physiological discomfort of patients. In view of the patients' negative emotions, the nursing staff dealt with that in a timely and targeted manner by giving patients great encouragement and support, and listening carefully and giving guidance to patients

and their families. The nursing staff were also responsible to guide patients to live a positive life and help them actively cooperate with health care workers. (3) Treatment and nursing: The nurses were responsible to guide patients to drink more water and regularly add distilled water at proper temperature to the oxygen humidifier and maintain the freshness of the humidified water every day. The water temperature in the atomizing tank was adjusted to 35-38°C. The sputum excretion position was changed in time, the respiration and heart rate was closely observed, and effective sputum aspiration was performed for the patient with excessive sputum. The nursing staff also paid attention to aseptic operation during sputum aspiration. Each sputum aspiration time was controlled within 15 s, and the number of consecutive sputum aspiration was within 3 times. In the process of sputum aspiration, the depth of the pipe was less than 18 cm. For mask atomization inhalation, the nursing staff should pay attention to the components and proportion of drugs injected into humidifier, and guide patients to inhale deeply and exhale slowly in time. After nursing for one week, the indices of the patients were tested in both groups.

Outcome measures

Primary outcome measures: (1) After nursing, the quality of life (QOL) of patients in both groups was assessed by WHOQOL-BREF [14]. Four dimensions (physiology, psychology, social relations and social environment) were assessed, with the total score of each dimension of 100 points. The higher the score, the higher the QOL. (2) The nursing satisfaction of patients was assessed through questionnaire survey, including three grades: great satisfaction, satisfactory and unsatisfactory.

Secondary outcome measures: (1) The hospitalization time and expenses were recorded and compared between CG and OG. (2) After nursing for one week, the number of patients with spontaneous expectoration, assisted expectoration and sputum aspiration was recorded in both groups. The effective rate of expectoration was calculated. Effective rate of expectoration = [(number of spontaneous expectoration + number of assisted expectoration)/ total number] ×100%. (3) Before and after

nursing, the levels of the partial pressure of blood oxygen (PaO_2), blood oxygen saturation (SaO_2) and partial pressure of carbon dioxide ($PaCO_2$) were measured by automatic blood gas analyzer in both groups. (4) Before and after nursing, the lung function of the patients was tested by lung function tester in both groups, including maximum expiratory flow rate (PEF), forced vital capacity (FVC) and forced expiratory volume in one second (FEV1). (5) After nursing for one week, the sputum excretion volume, respiratory rate and neutrophils were recorded and compared in both groups.

Statistical methods

SPSS 20.0 was applied for statistical analysis of the data. The measurement data were represented by mean number ± standard deviation. Independent t test was applied for comparison between the two groups. Paired-t test was applied for comparison before and after nursing. Chi-squared test was applied for comparison of the counting data. $P<0.05$ indicated that the difference was statistically significant.

Results

Comparison of baseline data

There was no striking difference in gender, age, BMI and educational level between the two groups (all $P>0.05$), indicating that the two groups were comparable (**Table 1**).

Comparison of hospitalization time and expenses between the two groups

In this study, we compared the length of hospital stay and treatment cost between the two groups. It was found that the average length of stay of OG was significantly shorter than that of CG (all $P<0.01$), and the average hospitalization expenses of OG was significantly lower (all $P<0.01$) (**Table 2**).

Comparison of the effective rate of sputum excretion between the two groups

In this study, we also compared the sputum excretion of the two groups. It was found that in the OG, there were 31, 15 and 2 patients with spontaneous expectoration, auxiliary expectoration and sputum extraction, and the effective sputum excretion rate was 95.83%,

Table 1. Baseline data

Factors	OG (n=48)	CG (n=40)	χ^2	P
Gender			0.024	0.876
Male	26 (54.17)	21 (52.50)		
Female	22 (45.83)	19 (47.50)		
Age/years old			0.099	0.753
≤71	20 (41.63)	18 (45.00)		
>71	28 (58.33)	22 (55.00)		
BMI (kg/m^2)			0.038	0.846
≤23	23 (47.92)	20 (50.00)		
>23	25 (52.08)	20 (50.00)		
Smoking history			0.126	0.723
Yes	21 (43.75)	16 (40.00)		
No	27 (56.25)	24 (60.00)		
Alcoholism history			0.009	0.923
Yes	10 (28.83)	8 (20.00)		
No	38 (79.17)	32 (80.00)		
Educational level			0.183	0.669
Below high school	23 (47.92)	21 (52.50)		
High school and above	25 (52.08)	19 (47.50)		

while there were 22, 8 and 10 cases of spontaneous expectoration, auxiliary expectoration and sputum aspiration in the CG, with an excretion rate was 75.00%. The effective rate of sputum excretion in the OG was significantly higher than that in the CG (all P<0.05) (**Table 3**).

Comparison of the changes of blood gas related indices between the two groups before and after nursing

The changes of PaO_2, SaO_2 and PCO_2 in the two groups before and after nursing were detected by blood gas analyzer. There was no significant difference in PaO_2, SaO_2 and PCO_2 levels between CG and OG before nursing (all P>0.05). Compared with before nursing, the levels of PaO_2, SaO_2 and PCO_2 in both groups were significantly improved after nursing (P<0.05), but the levels in the OG were significantly higher than those in the CG (all P<0.05) (**Figure 1**).

Comparison of lung function between the two groups before and after nursing

The changes of PEF, FVC and FEV1 in the two groups were assessed by pulmonary function tester. There was no significant difference in PEF, FVC and FEV1 between both groups be-

fore nursing (P>0.05). Compared with before treatment, the three indices were improved, but the OG was significantly higher than the CG (all P<0.05) (**Figure 2**).

Comparison of sputum excretion volume, respiratory rate and neutrophils between the two groups after nursing for one week

After nursing intervention, the sputum volume, respiratory rate and neutrophil count of OG were significantly lower than those of CG, with statistical difference (all P<0.05) (**Table 4**).

Comparison of QOL between the two groups after nursing

The changes of QOL in the two groups were compared by WHOQOL-BREF score. It was found that compared with CG, the scores of QOL (physiology, psychology, social relations and environment) in the OG after nursing were significantly improved, and the difference was statistically significant (P<0.05) (**Table 5**).

Comparison of nursing satisfaction between the two groups

In OG, the number of patients who were very satisfied, satisfied and dissatisfied with nursing was 30, 17 and 1 respectively, and the satisfaction rate was 97.92%. In CG, the number of patients who were very satisfied, satisfied and dissatisfied with nursing was 15, 12 and 13 respectively, and the rate was 78.72%. The nursing satisfaction of patients in OG was obviously higher than that in CG, with statistically significant difference (P<0.05) (**Table 6**).

Discussion

Pulmonary infection often develops in the elderly [15]. Due to the weak respiratory mucociliary movement ability of the elderly, many patients may have increased airway secretion in the case of concurrent infection, which may block the airway and affect the pulmonary ventilation function [16, 17]. In addition, the airway will be blocked when there is more sputum, thus threatening the safety of patients [18]. Therefore, the key to effectively control infec-

Table 2. Comparison of hospitalization time and hospitalization expense between the two groups

Items	OG (n=48)	CG (n=40)	t	P
Hospitalization time (days)	13.11±2.36	16.73±2.45	7.042	<0.001
Hospitalization expenses (RMB)	6986.84±813.96	7895.23±911.47	4.920	<0.001

Table 3. Comparison of the effective rate of sputum excretion between the two groups

Factors	OG (n=48)	CG (n=40)	χ^2	P
Spontaneous expectoration	31 (64.58)	22 (55.00)	-	-
Assisted expectoration	15 (31.25)	8 (20.00)	-	-
Sputum aspiration	2 (4.17)	10 (25.00)	-	-
Effective rate of sputum excretion	46 (95.83)	30 (75.00)	8.041	0.005

tion and shorten the course of disease is to effectively remove secretions in respiratory tract. Research [19] has revealed that scientific nursing mode can effectively control the pulmonary infection of patients.

In our research, we analyzed the effect of comprehensive expectoration nursing on patients with pulmonary infection. Compared with the conventional nursing mode, significantly less hospitalization time and expenses were found in patients receiving comprehensive expectoration nursing, suggesting that comprehensive expectoration nursing can effectively promote the recovery of patients. We have compared the effective rate of sputum excretion between the two groups. The effective rate of sputum excretion of the patients receiving comprehensive expectoration nursing was obviously higher than that in the control group. Conventional traditional nursing includes telling patients to take medicine on time and following the doctor's advice. However, due to the nonstandard expectoration method and inadequate implementation of expectoration, conventional nursing may not effectively guarantee the expectoration effect, which leads to poor prognosis of patients [20]. Expectoration nursing can ensure that patients excrete sputum through standard methods, thus preventing airway obstruction [21] with better sputum excretion efficiency. We also compared the blood gas and lung function related indices in both groups. The results showed that the blood gas and lung function of patients in the two groups were effectively ameliorated after nursing, but the OG was obviously better than the CG. This demonstrates that comprehensive expectoration nursing can effectively improve the pulmonary function and blood gas indices of patients. At present, comprehensive

expectoration nursing has shown remarkable advantages in improvement of the expectoration efficiency and lung function of patients with lung diseases. For example, it has been shown that comprehensive expectoration nursing in patients receiving thoracic surgery can effectively improve the expectoration effect and reduce the lung infection [22].

The sputum volume, respiratory rate and neutrophil count of patients in OG were lower than those in CG, which further suggests that comprehensive expectoration nursing could effectively promote sputum excretion and improve pulmonary infection in patients with pulmonary infection. The reason may be that in addition to the basic anti infection and expectorant measures, we also guide patients to develop good habits and supervise patients to drink more water, which may effectively promote the moisture and repair of respiratory mucosa, and thus, reduce the probability of respiratory cross-infection [23, 24]. We also guide the breathing position, so that the patients can take a sitting or standing position to actively and effectively cough up sputum [25]. In the process of sputum aspiration, patients are constantly adjusted to ensure that the sputum can be eliminated efficiently [26]. In the comprehensive expectoration nursing, these measures can effectively help patients to discharge sputum and recover lung function. The quality of life and nursing satisfaction between the two groups were also compared. Significantly improved quality of life and nursing satisfaction were observed in the patients of OG compared with those in CG. This demonstrates that comprehensive expectoration nursing can effectively improve the quality of life and nursing satisfaction [27].

We have demonstrated that comprehensive expectoration nursing in elderly patients with pulmonary infection was better than conven-
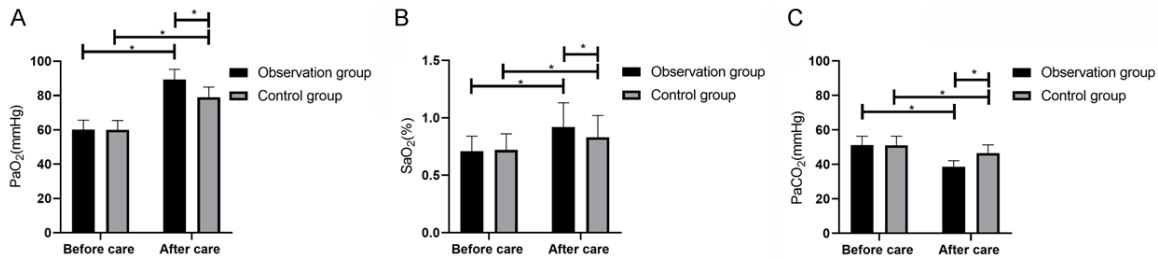
Figure 1. Comparison of the changes of blood gas related indices between the two groups before and after nursing; A: Comparison of PaO_2 changes; B: Comparison of SaO_2 changes; C: Comparison of PCO_2 changes. * indicates P<0.05.
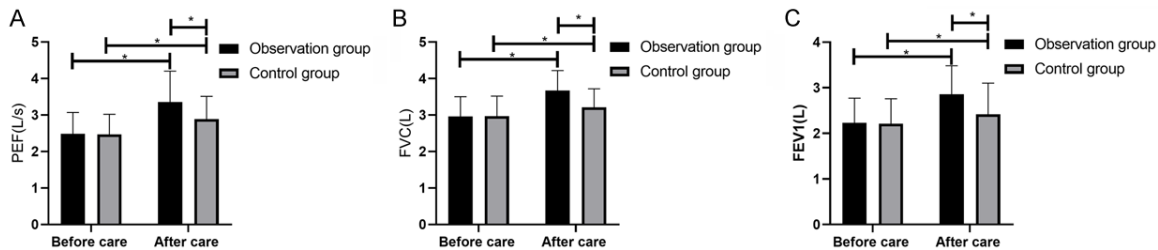

Figure 2. Comparison of lung function between the two groups before and after nursing; A: Comparison of PEF changes; B: Comparison of FVC changes; C: Comparison of FEV1 changes. * indicates P<0.05.

Table 4. Comparison of sputum excretion volume, respiratory rate and neutrophils between the two groups after nursing for one week

Items	OG (n=48)	CG (n=40)	t	P
Sputum volume (ml)	9.81±1.57	14.95±2.03	13.39	<0.001
Respiratory rate (times/min)	16.75±0.52	19.12±0.27	26.03	<0.001
Neutrophil count (10^9/L)	4.25±0.43	5.62±0.55	13.11	<0.001

Table 5. Comparison of quality of life between the two groups

Factors	OG (n=48)	CG (n=40)	t	P
Physiology	91.16±4.32	82.15±4.04	10.03	<0.001
Psychology	83.25±3.14	71.37±2.62	19.03	<0.001
Social relations	84.21±3.67	71.23±2.85	18.24	<0.001
Social environment	91.97±4.31	83.22±2.71	11.13	<0.001
Society	63.52±2.11	52.57±2.85	20.68	<0.001

Table 6. Comparison of nursing satisfaction between the two groups [n (%)]

Groups	OG (n=48)	CG (n=40)	X^2	P
Great satisfaction	30 (62.50)	15 (37.50)	-	-
Satisfactory	17 (35.42)	12 (30.00)	-	-
Dissatisfied	1 (2.08)	13 (21.28)	-	-
Nursing satisfaction	47 (97.92)	37 (78.72)	8.545	0.004

tional nursing modality. However, this study still has some limitations. As a retrospective study,

our data may be biased. Thus, we hope to carry out prospective research in the future to improve the validity of our conclusions.

To sum up, comprehensive expectoration nursing can not only effectively improve the expectoration efficiency and pulmonary function of patients with pulmonary infection. It can also improve their quality of life and nursing satisfaction.

Disclosure of conflict of interest

None.

Address correspondence to: Jiayi Chen, Geriatric and General Medicine Department, Nantong First People's Hospital, No. 6 North Child Lane Road, Chongchuan District, Nantong 226001, Jiangsu Province, China. Tel: +86-15962948535; E-mail: chenjiayi0618@163.com

References

[1] Kelly AM and McLoughlin RM. Target the host, kill the bug; targeting host respiratory immuno-suppressive responses as a novel strategy to improve bacterial clearance during lung infection. Front Immunol 2020; 11: 767.

[2] Shu-Ping QI, Jin-Yan WU, Duan FX, Zheng HY, Huang Q, Fan FH and Hospital Z. Drug resistance of pathogens isolated from elderly patients with pulmonary infections. Chinese Journal of Nosocomiology 2018; 9: 1345-1347.

[3] Ata F, Yousaf Q, Veliyankodan Parambil J, Parengal J, Mohamedali MG and Yousaf Z. A 28-year-old man from india with SARS-Cov-2 and pulmonary tuberculosis co-infection with central nervous system involvement. Am J Case Rep 2020; 21: e926034.

[4] Ji X, Cui W, Zhang B and Shan S. Effect of lung protective ventilation on perioperative pulmonary infection in elderly patients with mild to moderate COPD under general anesthesia. J Infect Public Health 2020; 13: 281-286.

[5] Tewes F, Bahamondez-Canas TF, Moraga-Espinoza D, Smyth HDC and Watts AB. In vivo efficacy of a dry powder formulation of ciprofloxacin-copper complex in a chronic lung infection model of bioluminescent pseudomonas aeruginosa. Eur J Pharm Biopharm 2020; 152: 210-217.

[6] Duffney PF, Embong AK, McGuire CC, Thatcher TH, Phipps RP and Sime PJ. Cigarette smoke increases susceptibility to infection in lung epithelial cells by upregulating caveolin-dependent endocytosis. PLoS One 2020; 15: e0232102.

[7] Pylaeva E, Bordbari S, Spyra I, Decker AS, Haussler S, Vybornov V, Lang S and Jablonska J. Detrimental effect of type I IFNs during acute lung infection with Pseudomonas aeruginosa is mediated through the stimulation of neutrophil NETosis. Front Immunol 2019; 10: 2190.

[8] Huang F, van den Hof S, Qu Y, Li Y, Zhang H, Wang L, Sun M, Lu W, Hou S, Zhang T, Huan S, Chin DP and Cobelens F. Added value of comprehensive program to provide universal access to care for sputum smear-negative drug-resistant tuberculosis, China. Emerg Infect Dis 2019; 25: 1289-1296.

[9] Chen YC, Wu LF, Mu PF, Lin LH, Chou SS and Shie HG. Using chest vibration nursing intervention to improve expectoration of airway secretions and prevent lung collapse in ventilated ICU patients: a randomized controlled trial. J Chin Med Assoc 2009; 72: 316-322.

[10] Pascoal LM, Lopes MV, da Silva VM, Chaves DB, Beltrao BA, Nunes MM and de Moura KK. Clinical differentiation of respiratory nursing diagnoses among children with acute respiratory infection. J Pediatr Nurs 2016; 31: 85-91.

[11] Karino F, Miura K, Fuchita H, Koba N, Nishikawa E, Hotta T, Okimoto T, Iwamoto S, Tsubata Y, Tada M, Hamaguchi S, Honda T, Ohe M, Sutani A, Kuraki T, Takeyama H and Isobe T. Efficacy and safety of piperacillin/tazobactam versus biapenem in late elderly patients with nursing- and healthcare-associated pneumonia. J Infect Chemother 2013; 19: 909-915.

[12] Loeb MB, Carusone SB, Marrie TJ, Brazil K, Krueger P, Lohfeld L, Simor AE and Walter SD. Interobserver reliability of radiologists' interpretations of mobile chest radiographs for nursing home-acquired pneumonia. J Am Med Dir Assoc 2006; 7: 416-419.

[13] Uruga H, Moriguchi S, Takahashi Y, Ogawa K, Murase R, Hanada S, Miyamoto A, Morokawa N and Kishi K. Clinical analysis of 115 pulmonary tuberculosis patients with sputum smear-negative. Kekkaku 2017; 92: 361-364.

[14] Iqbal MS, Kassab YW, Al-Saikhan FI, Almalki ZS, Haseeb A, Iqbal MZ and Ali M. Assessing quality of life using WHOQOL-BREF: a cross-sectional insight among patients on warfarin in Malaysia. Saudi Pharm J 2020; 28: 936-942.

[15] Cribbs SK, Crothers K and Morris A. Pathogenesis of HIV-related lung disease: immunity, infection, and inflammation. Physiol Rev 2020; 100: 603-632.

[16] Scharenberg M, Vangeti S, Kekalainen E, Bergman P, Al-Ameri M, Johansson N, Sonden K, Falck-Jones S, Farnert A, Ljunggren HG, Michaelsson J, Smed-Sorensen A and Marquardt N. Influenza A virus infection induces hyperresponsiveness in human lung tissue-resident and peripheral blood NK cells. Front Immunol 2019; 10: 1116.

[17] Beckmann N, Pugh AM, Auteri NJ, Edwards MJ, Gulbins E and Caldwell CC. Therapeutic inhaled sphingosine for treating lung infection in a mouse model of critical illness. Cell Physiol Biochem 2020; 54: 1054-1067.

[18] Mahowald M, Shahan B and Forbes D. Respiratory conditions: lower respiratory tract infections. FP Essent 2019; 486: 19-25.

[19] Griebling TL. Re: constitutional symptoms trigger diagnostic testing before antibiotic prescribing in high-risk nursing home residents. J Urol 2017; 197: 708.

[20] Ames NJ, Ranucci A, Moriyama B and Wallen GR. The human microbiome and understanding the 16S rRNA gene in translational nursing science. Nurs Res 2017; 66: 184-197.

[21] Huang R, Lin W, Fan H, Lu G, Yang D, Ma L and Lin J. Bronchoalveolar lavage with pediatric flexible fibreoptic bronchoscope in pediatric haematopoietic stem cell transplant patients:

nursing considerations for operative complications. J Spec Pediatr Nurs 2019; 24: e12236.

[22] Kowada A. Cost-effectiveness of interferon-gamma release assays for tuberculosis screening in nursing homes. Epidemiol Infect 2016; 144: 3215-3225.

[23] Pinto JM, Schairer JL and Petrova A. Comparative effectiveness of implementation of a nursing-driven protocol in reducing bronchodilator utilization for hospitalized children with bronchiolitis. J Eval Clin Pract 2014; 20: 267-272.

[24] Schijf MA, Kruijsen D, Bastiaans J, Coenjaerts FE, Garssen J, van Bleek GM and van't Land B. Specific dietary oligosaccharides increase Th1 responses in a mouse respiratory syncytial virus infection model. J Virol 2012; 86: 11472-11482.

[25] Maksic H, Heljic S, Skokic F, Sumanovic-Glamuzina D, Milosevic V, Zlatanovic A and Gerard N. Predictors and incidence of hospitalization due to respiratory syncytial virus (RSV)-associated lower respiratory tract infection (LRTI) in non-prophylaxed moderate-to-late preterm infants in Bosnia and Herzegovina. Bosn J Basic Med Sci 2018; 18: 279-288.

[26] Schwendicke F, Stolpe M and Muller F. Professional oral health care for preventing nursing home-acquired pneumonia: a cost-effectiveness and value of information analysis. J Clin Periodontol 2017; 44: 1236-1244.

[27] McClester Brown M, Sloane PD, Kistler CE, Reed D, Ward K, Weber D and Zimmerman S. Evaluation and management of the nursing home resident with respiratory symptoms and an equivocal chest X-ray report. J Am Med Dir Assoc 2016; 17: 1164.e1-1164.e5.