

5E-led hospital-community-family care in patients with lung cancer surgery: it does work

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Abstract

Introduction: Postoperative pulmonary rehabilitation is a very important part of the treatment and nursing care of patients with lung cancer. We aimed to evaluate the effects of the 5E (encouragement, education, exercise, employment and evaluation)-led hospital-community-family care model in patients with lung cancer.

Material and methods: Patients with lung cancer undergoing surgical treatment in our hospital between January 1, 2021 and February 15, 2022 were selected. The patients were randomly assigned to the control and 5E group. The cardio-pulmonary function, quality of life and psychosocial adjustment level were evaluated and compared.

Results: A total of 154 patients with lung cancer comprising 78 patients in the control group and 76 patients in the 5E groups were included. There were significant differences in the forced expiratory volume in 1 s (FEV₁), forced vital capacity (FVC) at 1 month, 3 months and 6 months follow-up between the two groups (all $p < 0.05$). There were significant differences in the FEV₁/FVC and peak expiratory flow (PEF) at 6 months follow-up between the control group and 5E group (all $p < 0.05$). There were significant differences in the 6 min walking test (6MWT), World Health Organization Quality of Life-100 Scale (WHOQOL-100) score and Self-report Psycho-social Adjustment to Illness Scale (PAIS-SR) score at 1 month, 3 months and 6 months follow-up between the two groups (all $p < 0.05$).

Conclusions: The 5E-led hospital-community-family care model is beneficial to improve the cardiopulmonary function and quality of life in patients with lung cancer, which may be worth promoting and using in clinical care of patients with lung cancer.

Key words: lung cancer, pulmonary, rehabilitation, quality of life, care, treatment.

Introduction

Lung cancer is one of the malignant tumors with the highest morbidity and mortality worldwide [1]. According to reports [2], there are about 18.1 million new cancer cases and 9.6 million cancer deaths in the world, among which new cases of lung cancer account for 11.6% and death cases account for 18.4%, ranking first in the mortality rate of major tumors.

Surgery is the first choice for early-stage lung cancer, but patients often experience incision pain, cough, and psychological stress after surgery, which seriously affects the recovery of pulmonary rehabilitation and quality of life [3]. During the recovery process of most lung cancer patients after surgery, whether they obtain standardized and continuous health care services during the recovery period is related to the level of patients' quality of life [4]. The quality of life of patients depends to a considerable extent on the physiological and psychological states of the patients. Relevant studies [5] have shown that the level of the physiological state of patients undergoing pulmonary surgery is closely associated with the recovery of their pulmonary function after discharge from the hospital. The level of lung function and mood are the key to measure the quality of life of patients, which to a certain extent reflects the necessity of continuous nursing care.

The 5E rehabilitation model [6] was proposed by the International Rehabilitation Association in 1994, including five parts: encouragement, education, exercise, employment, and evaluation. Comprehensive rehabilitation nursing intervention promotes the establishment of positive cognitive models in patients with chronic diseases, promotes effective disease coping and healthy behaviors, and promotes disease recovery [7]. The 5E rehabilitation program emphasizes stimulating the patient's potential, and believes that the patient himself plays a leading role in the entire rehabilitation process [8]. A previous study [9] showed that the 5E rehabilitation program can effectively improve the health level and quality of life of patients with chronic diseases by enhancing the patient's awareness of and attention to the disease, improving the patient's self-management and self-care ability, and encouraging the patient to maintain the long-term rehabilitation process. At present, this model is widely used in the rehabilitation care of patients with chronic diseases such as diabetes, coronary heart disease, chronic obstructive pulmonary disease (COPD), and stroke [10–12], but it has not been reported in the population of patients with lung cancer.

In recent years, more and more scholars have projected their vision to the community, and have taken the linkage of "hospital-community-family" as an important focus of the continuous nursing care model. In the hospital-community-family nursing care model, the provision of medical and health services is not independent of tertiary hospitals and community health service centers, but involves mutual cooperation, integration of advantages, complementation of resources, and a collaborative approach to patients and through interaction with them [13]. It is an innovative model that focuses on patient health and provides

holistic, individualized and continuous health services. The hospital-community-family nursing care model has been applied to the management of patients with chronic diseases, such as the management of patients with hyperuricemia and the management of stroke patients [14]. At present, the scales commonly used to measure the quality of life of patients are the Short Form 36 (SF-36) questionnaire and the World Health Organization Quality of Life-100 Scale (WHOQOL-100). It has been reported that SF-36 assessment of quality of life is universal, but WHOQOL-100 assessment of patients' quality of life is more detailed and comprehensive [15]. It is worth noting that there are very few studies on the effects of the 5E-led hospital-community-family nursing care model on the rehabilitation of surgical patients. It is necessary to evaluate the impact of this care model on the postoperative pulmonary function and quality of life of patients with lung cancer [16].

Therefore, we aimed to analyze the effects of the 5E-led hospital-community-family nursing care model in patients with lung cancer, to provide reliable evidence and insights to the clinical treatment and nursing care of patients with lung cancer.

Material and methods

Ethics

This study has a prospective cohort design, the study protocol has been checked and approved by the ethical committee of our hospital (approval number: 220095), and written informed consent has been obtained from all the included patients.

Sample size calculation

We used this formula [17] for sample size calculation:

$$n = \frac{(u_{\alpha} + u_{\beta})^2 2p(1-p)}{(p_1 - p_2)^2}.$$

p_1 was the incidence of unmet needs in the control group, p_2 was the incidence of unmet needs in the intervention group, $p = (p_1 + p_2)/2$. Z_{α} and Z_{β} are the corresponding values of the test level α and the type II error probability β ; we set $\alpha = 0.05$, $\beta = 0.1$, two-sided test $Z_{\alpha/2} = 1.96$, $Z_{\beta} = 1.282$. According to the results of the literature research, p_1 and p_2 were 0.53 and 0.8 respectively, the calculated sample size of a single group was 69, and considering the 10% loss rate, there should be 76 cases in each group.

Patients

In this study, patients with lung cancer who underwent surgery in our hospital between January 1, 2021 and February 15, 2022 were selected as the

research population. The inclusion criteria of patients were: 1) adult patients with lung cancer; 2) patients received partial pulmonary resection; 3) patients agreed to voluntarily participate in this study and completed follow-up. The exclusion criteria of patients were: 1) Patients with severe heart, liver, kidney and other important organ insufficiency; 2) Patients with a history of mental illness or cognitive impairment; 3) patients who were unwilling to participate in the study. The patients were randomly assigned to the control and 5E groups based on a computer-generated random sequence.

Interventions

The control group accepted the routine nursing care, including routine treatment, nursing and traditional health education materials distribution and health education. The 5E group accepted the 5E led hospital-community-family pulmonary rehabilitation management model. We have established a hospital-community-family three-in-one management model led by the 5E rehabilitation model, and standardized the work responsibilities of personnel at all levels. Firstly, after admission, a hospital-community-family nursing service group was established, including hospital specialist nurses, community nurses and family members of patients. All personnel maintained corresponding contacts through platforms such as WeChat and telephone. After the patient was admitted to the hospital, the specialist physicians and specialist nurses in the hospital assessed the pulmonary function, encouraged the patient through verbal or non-verbal forms, stimulated the patient's positive emotions, and established confidence in functional rehabilitation training activities. This is the "encouragement and education" in the 5E model, which was completed by the nurses in the hospital. After being transferred to the relevant community health service unit, specialist nurses would transfer the patient's personal information, hospitalization information and other relevant content to community service personnel, and conduct regular community outpatient follow-up. Community nurses guided patients and their families to carry out relevant family rehabilitation training, promoted disease recovery, and developed good living habits. This was the "exercise" part of the 5E model, which was completed by community nurses. Family support meant that family members of patients actively participated in daily self-care, functional exercise, etc., integration into society, participated in various activities, and resumed work, etc., during their hospitalization and discharge. This was the "work" part of the 5E model, which was done with family members together. Community service personnel regu-

larly checked the effect of patient's exercise. This was the "assessment" part of the 5E model, which was completed by community nurses. Hospital nurses, community nurses, and family members had a clear division of responsibilities, cooperated with each other, and gave full play to their roles.

Outcome evaluation

Questionnaires and pulmonary function tests were distributed to patients before surgery, at discharge, 1 month, 3 months, and 6 months after discharge to complete the data collection and survey.

Pulmonary function assessment: We used the Spirometer (Master Screen, Yale, Master-Screen, Jaeger Germany) with the flow-volume curve mode, to measure the patient's FEV₁, FEV₁/FEV% ratio, and peak expiratory flow (PEF). Each patient was tested at least 3 times, and the average data were taken. In addition, we assessed patients' cardiorespiratory endurance levels at various time points using the 6-min walk test (6MWT).

Quality of life: The WHOQOL-100 [18, 19] has validated for the Chinese population and was used for the evaluation of quality of life. The scale included 6 areas including independence, physiology, environment, etc. The full score of the WHOQOL-100 is 100 points – the higher the score, the better the quality of life of the patient.

Psychosocial adjustment level: We used the Self-report Psycho-social Adjustment to Illness Scale (PAIS-SR) [20] as an assessment tool to assess the patient's level of psychosocial adjustment. This scale was developed by Professor Leonard to measure the psychosocial adaptation of patients. The scale contains a total of 7 dimensions (work ability, communication ability, health care, family relationship, sexual ability, entertainment situation and overall psychological condition) with a total of 44 items, each with a Likert 4-level score (divided into 0–3 points, totaling 132 points). The higher the score is, the greater is the necessity to improve the psychosocial adjustment level. It was reported that the internal consistency coefficient Cronbach's α coefficient of the translated version (Chinese) of the scale was 0.872, indicating good reliability and validity [21].

Statistical analysis

We used SPSS 20.0 statistical software to analyze the data. Measurement data were expressed as mean \pm standard deviation, the two independent samples *t*-test was used for comparison between two groups, and the paired *t*-test was used for comparison of the same group before and after intervention; enumeration data were expressed as number of cases and rate (%), and the χ^2 test was

used for comparison between groups. The rank sum test was used for comparison of grade data. In this study, $p < 0.05$ was considered as a statistically significant difference between groups.

Results

Patient inclusion and characteristics

We first identified 172 potential patients; 160 patients were eligible for inclusion, and were randomly assigned to the control and 5E groups. Two patients in the control group were lost to follow-up at 3 and 4 months due to the patients moving to other distant communities, and 4 patients in the 5E groups were lost to follow-up at 1 and 3 months due to the patients moving to other distant communities and cities. Finally, a total of 154 patients with lung cancer were included, comprising 78 patients in the control group and 76 patients in the 5E groups (Figure 1).

The characteristics of patients with lung cancer are shown in Table I. There were no significant differences in the gender, age, hypertension, diabetes, hyperlipidemia, surgical approach, pathological type, postoperative tumor stage and duration of surgery between the control group and 5E group (all $p > 0.05$).

Pulmonary function indexes

As shown in Table II, there were significant differences in the FEV₁, FVC at 1 month, 3 months

and 6 months follow-up between the control group and 5E group (all $p < 0.05$). There were significant differences in the FEV₁/FVC and PEF at 6 months follow-up between the control group and 5E group (all $p < 0.05$), indicating that the 5E-led hospital-community-family nursing care model is beneficial to improve the pulmonary function in patients with lung cancer.

6MWT

As shown in Table III, there were significant differences in the 6MWT at the 1 month, 3 months and 6 months follow-up between the control group and 5E group (all $p < 0.05$), indicating that the 5E-led hospital-community-family nursing care model is beneficial to improve the cardio-pulmonary function in patients with lung cancer.

WHOQOL-100 score

As shown in Table IV, there were significant differences in the WHOQOL-100 at the 1 month, 3 months and 6 months follow-up between the control group and 5E group (all $p < 0.05$), indicating that the 5E-led hospital-community-family nursing care model is beneficial to improve the quality of life in patients with lung cancer.

PAIS-SR score

As shown in Table V, there were significant differences in the PAIS-SR score at the 1 month,

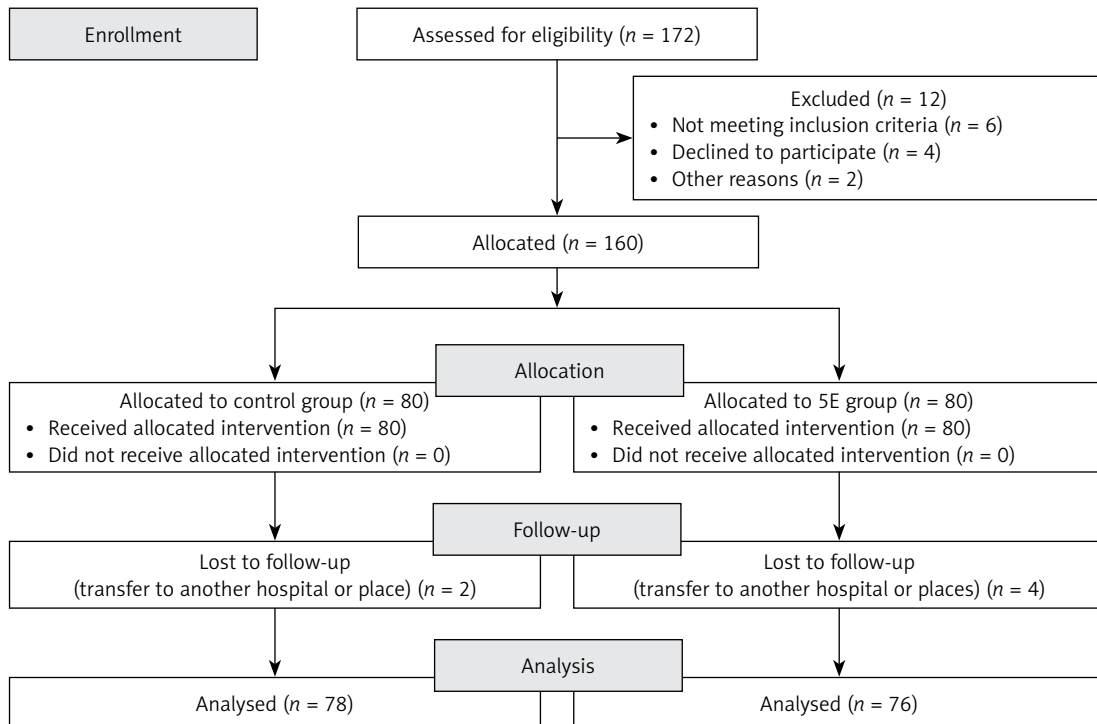


Figure 1. CONSORT flow diagram of patient selection

Table I. Characteristics of patients with lung cancer

Variables	Control group (n = 78)	5E group (n = 76)	t/ χ^2	P-value
Male/female	49/29	49/27	1.816	0.102
Age	62.03 \pm 7.22	63.14 \pm 8.86	7.224	0.071
Hypertension	38 (48.72%)	39 (51.32%)	1.387	0.117
Diabetes	16 (20.51%)	14 (18.42%)	1.203	0.104
Hyperlipidemia	10 (12.82%)	9 (11.84%)	1.055	0.129
Surgical approach:			2.873	0.085
Unilateral lobectomy	42 (53.85%)	40 (52.63%)		
Upper lobectomy	14 (17.95%)	16 (21.05%)		
Middle lobectomy	10 (12.82%)	8 (10.53%)		
Lower lobectomy	11 (14.11%)	11 (14.47%)		
Single leaf partial wedge resection	36 (46.15%)	38 (50%)		
Pathological type:			1.665	0.131
Squamous cell carcinoma	11 (14.10%)	7 (9.21%)		
Adenocarcinoma	67 (85.90%)	69 (90.79%)		
Postoperative tumor stage:			2.242	0.117
Carcinoma <i>in situ</i>	21 (26.92%)	18 (23.68%)		
Stage IA	54 (69.23%)	55 (72.37%)		
Stage IIA	3 (3.85%)	3 (3.95%)		
Duration of surgery [min]	211.02 \pm 55.42	220.98 \pm 58.25	9.183	0.101

Table II. Comparison of pulmonary function indexes in two groups of patients

Variables	Control group (n = 78)	5E group (n = 76)	t	P-value
FEV ₁ [l]:				
Before surgery	2.35 \pm 0.63	2.39 \pm 0.69	1.112	0.105
At discharge	2.36 \pm 0.61	2.35 \pm 0.59	1.094	0.113
At 1 month follow-up	2.57 \pm 0.71	2.89 \pm 0.64	1.128	0.041
At 3 months follow-up	2.77 \pm 0.55	3.02 \pm 0.71	1.742	0.021
At 6 months follow-up	2.99 \pm 0.72	3.18 \pm 0.65	1.032	0.035
FVC [l]:				
Before surgery	2.98 \pm 0.70	2.99 \pm 0.64	1.134	0.092
At discharge	2.46 \pm 0.71	2.44 \pm 0.61	1.207	0.103
At 1 month follow-up	2.73 \pm 0.68	2.95 \pm 0.72	1.182	0.044
At 3 months follow-up	2.95 \pm 0.74	3.19 \pm 0.63	1.132	0.015
At 6 months follow-up	3.10 \pm 0.64	3.29 \pm 0.73	1.107	0.045
FEV ₁ /FVC (%):				
Before surgery	80.24 \pm 7.01	80.21 \pm 6.94	3.192	0.108
At discharge	80.20 \pm 8.25	80.24 \pm 8.26	2.848	0.115
At 1 month follow-up	80.38 \pm 7.97	80.41 \pm 8.44	3.182	0.059
At 3 months follow-up	80.40 \pm 9.21	80.43 \pm 8.15	3.109	0.074
At 6 months follow-up	80.64 \pm 8.45	81.07 \pm 9.29	2.844	0.034
PEF [l/s]:				
Before surgery	5.99 \pm 1.58	6.02 \pm 1.39	1.182	0.116
At discharge	6.10 \pm 1.78	6.14 \pm 1.85	1.284	0.102
At 1 month follow-up	6.19 \pm 1.63	6.21 \pm 1.28	1.178	0.094
At 3 months follow-up	6.31 \pm 1.95	6.38 \pm 1.77	1.192	0.088
At 6 months follow-up	6.43 \pm 1.81	6.69 \pm 1.95	1.182	0.036

FEV₁ – forced expiratory volume in 1 s, FVC – forced vital capacity, PEF – peak expiratory flow.

Table III. Comparison of 6MWT in two groups of patients

6MWT	Control group (n = 78)	5E group (n = 76)	t	P-value
Before surgery	411.52 ±116.58	416.06 ±104.91	11.203	0.093
At discharge	418.94 ±112.66	421.51 ±120.62	12.381	0.106
At 1 month follow-up	436.42 ±128.94	457.14 ±146.09	12.904	0.041
At 3 months follow-up	472.96 ±141.06	490.01 ±139.16	11.837	0.035
At 6 months follow-up	488.04 ±154.63	512.45 ±168.77	13.022	0.016

6MWT – 6 min walking test.

Table IV. Comparison of WHOQOL-100 score in two groups of patients

WHOQOL-100	Control group (n = 78)	5E group (n = 76)	t	P-value
Before surgery	51.96 ±19.08	52.09 ±18.93	7.114	0.085
At discharge	56.88 ±20.14	58.01 ±21.66	7.332	0.103
At 1 month follow-up	60.12 ±21.47	67.31 ±19.15	8.005	0.044
At 3 months follow-up	66.18 ±20.95	71.29 ±19.68	8.176	0.027
At 6 months follow-up	70.29 ±24.33	77.65 ±23.71	9.212	0.013

WHOQOL-100 – World Health Organization Quality of Life-100 Scale.

Table V. Comparison of PAIS-SR in two groups of patients

PAIS-SR	Control group (n = 78)	5E group (n = 76)	t	P-value
Before surgery	116.21 ±32.68	115.09 ±34.13	10.851	0.116
At discharge	108.12 ±29.64	109.63 ±29.13	11.987	0.103
At 1 month follow-up	99.08 ±31.44	92.49 ±30.12	10.416	0.037
At 3 months follow-up	89.42 ±30.12	81.85 ±27.28	11.072	0.031
At 6 months follow-up	80.28 ±29.05	77.83 ±25.94	13.124	0.025

PAIS-SR – Self-report Psycho-social Adjustment to Illness Scale.

3 months and 6 months follow-up between the control group and 5E group (all $p < 0.05$), indicating that the 5E-led hospital-community-family nursing care model is beneficial to reduce the need of psycho-social adjustment in patients with lung cancer.

Discussion

With the increasing incidence of lung cancer, China became the country with the highest incidence of lung cancer in the world in 2015, accounting for 26.1% [22]. In the treatment of lung cancer, surgery is the first choice for the treatment of early stage lung cancer [23]. Lung cancer surgery involves multiple factors such as intraoperative tracheal intubation, inhalation anesthesia, and postoperative pain, which seriously reduce the original respiratory function and airway clearance ability of patients [24]. The loss of lung tissue after lung cancer surgery will adversely affect the respiratory function, postoperative exercise performance and quality of life of patients for a long time [25]. It is very important to provide good pulmonary function rehabilitation training for the patient with lung cancer who underwent partial lung resection [26]. The results of this study have

found that the 5E-led hospital-community-family nursing care model is beneficial to improve the pulmonary function, 6MWT, quality of life and psycho-social adjustment in patients with lung cancer, which may be promoted in the nursing care and management of patients with lung cancer.

As early as the 1980s, the focus of national health work in the United States shifted from hospitals to primary care in the community. It has been reported that continuous care in communities in the United States, Britain and other countries is led by nurses, coordinating doctors, nutritionists, occupational therapists, etc., providing day services such as life guidance and rehabilitation care for patients who are still at high risk of hospitalization after discharge [27]. Continuous care service interventions in the United States mainly include comprehensive evaluation of health needs, guiding patients and caregivers to actively participate, assisting patients in managing symptoms, health education to improve self-care ability, providing coordinated continuous health support, and multidisciplinary professional team support [28]. Discharge planning is the process by which a patient with disabilities transitions smoothly from one setting to another, and is the process by which services are provided by

a multidisciplinary and integrated team, including the essential team, resource team, and community team [29]. The transitional nursing mode refers to the nursing mode in which the transitional nurses start the assessment, planning, implementation, evaluation, discharge, follow-up after discharge and other processes from the time the patient is admitted to the hospital, so as to ensure the coordination and continuity of the nursing work during the transitional period [30]. Clinical nursing experts or senior practice nurses are mainly used as case managers, who are responsible for the patient's cross-time care. Still, there are few relevant studies on the application of the hospital-community-family model in pulmonary rehabilitation.

The 5E rehabilitation model encourages patients through verbal or non-verbal forms, stimulates patients' positive emotions, builds confidence in disease recovery, and is conducive to disease recovery [31]. Some studies [32, 33] have used intervention strategies with the themes of encouragement, motivation and communication preferences, which effectively stimulated the motivation of patients with type 2 diabetes and improved their self-management ability and physical and mental health. Authors *et al.* [34] reported that family encouragement can effectively reduce the incidence of complications in patients with craniocerebral injury and improve their quality of life. In addition, the encouragement is infiltrated into the peer support among patients, the company and supervision of family members, and the interaction with medical staff, making full use of the patient's "external resources", which also contributes to positive psychological construction and improves the effect of rehabilitation treatment [35]. Patients need to have disease-related knowledge and self-care ability to promote health outcomes. Some scholars believe that the patient's disease-related knowledge and experience constitute a resource that needs to be developed [36]. The 5E rehabilitation model starts with education, which can develop the patient's own resources, enrich the patient's knowledge reserve, improve the patient's awareness of and attention to the disease, stimulate their intrinsic motivation, and enhance their disease behavioral coping ability [37]. Authors *et al.* [38] have enabled COPD patients to master the knowledge of exercise rehabilitation and nutritional support through group teaching, one-to-one education, and WeChat push, which is helpful for patients to maintain positive emotions and promote healthy behaviors. In addition, authors *et al.* [39] have constructed a rehabilitation nursing plan suitable for maintenance hemodialysis patients under the guidance of the 5E rehabilitation model, and have provided emotional support to patients in the form of peer

health education, etc., to improve the patients' physical fitness and quality control compliance.

The 5E rehabilitation model advocates that patients should exercise, formulate exercise prescriptions suitable for their physical fitness level and disease status, and select a reasonable exercise intensity, frequency, time, type, method and amount of exercise to ensure safe exercise [40]. Authors *et al.* [41] have designed a rehabilitation nursing plan suitable for diabetic patients based on the 5E rehabilitation model by instructing patients to choose jogging, walking, cycling, climbing stairs and other activities according to their exercise preferences and physical fitness, changing the patient's bad exercise habits, making the patient feel better, and helping ensure that the blood sugar levels of patients are effectively controlled. The 5E-led hospital-community-family nursing care model builds patient-centered multi-faceted rehabilitation care, guides hospitalized and discharged patients to actively participate in daily self-care, functional exercise, etc., and guides them to participate in social activities and return to work and life as soon as possible. Work is defined as performing appropriate housework (such as laundry, grocery shopping, cooking) or participating in other beneficial social activities, which can improve the level of self-efficacy in patients with chronic diseases and promote disease recovery [42]. The 5E-led hospital-community-family nursing care model through planned, purposeful and systematic collection of patient data, and comprehensive evaluation of patients, ensures scientific and effective implementation of rehabilitation nursing. During hospitalization, the 5E rehabilitation model requires evaluation of the patient's disease status, social background and psychological state, etc., establishing a patient health file, capturing the patient's health information and condition changes in real time, and formulating and timely adjusting the rehabilitation nursing plan [43, 44]. After the patient is discharged from the hospital, the 5E-led hospital-community-family nursing care model requires extended medical care services, dynamically assesses patients' health conditions, adjusts treatment plans and intervention measures in a timely manner, and gives timely and targeted guidance to patients about emerging health problems, to determine whether the intervention measures are scientific and effective, to achieve precise nursing, and to provide a basis for subsequent interventions and nursing care [45].

There are certain flaws in this study that deserve to be considered. Firstly, this study is a single-center intervention study with a small sample size, which makes it impossible to perform subgroup analysis on factors such as patient age, and the standard deviation is high in the 6MWT and

WHOQOL-100 score, which may be associated with the differences in patients' personal physique and family economic conditions. Secondly, the follow-up observation period of the patients in this study was short, and the follow-up was only followed for 6 months. The long-term effects of the two nursing modes on the pulmonary function and quality of life of the patients need more investigations. Thirdly, we did not examine the nursing satisfaction from health care providers and patients, yet nursing satisfaction is vital to the promotion of a nursing model; hence in future more studies on nursing satisfaction are warranted. Finally, we did not pre-register this study before the clinical study began. In the future, follow-up studies with large samples and high quality should be carried out to further explore the effects of the 5E-led hospital-community-family nursing care model in patients with lung cancer.

In conclusion, this study found that the 5E-led hospital-community-family nursing care model improves the cardio-pulmonary function, quality of life and psycho-social adjustment in patients with lung cancer. The 5E-led hospital-community-family nursing care model needs to integrate the resources of the hospital, the community and the patient's family, and strengthen nursing and assistance in various fields to improve the prognosis of patients. It is of great significance to improve the prognosis and quality of life of lung cancer patients, which may be worthy of promotion in clinical, community and home care for patients with lung cancer.

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Lingyan Jiang, Fengqiu Sun, Yingying Tang – equal contributor.

Conflict of interest

The authors declare no conflict of interest.

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