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RESEARCH ARTICLE

Development of mobile health–based self-management support for patients with lung cancer: A stepwise approach

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Abstract

Aim: To develop self-management support platform on mobile for Chinese patients with lung cancer.

Design: A stepwise approach with combination of methods.

Methods: Literature review was carried out to construct preliminary framework and develop detailed content for self-management modules. A semistructured interview was conducted to elicit preference in the content and platform of self-management modules with 15 patients with lung cancer. Delphi study was performed to evaluate and improve the content of modules with 13 experts. A pilot study was conducted to test the mobile health–based self-management support modules with 13 patients with lung cancer.

Results: A social network software-based WeChat public account "Symptom Self-Management" for patients with lung cancer was developed and preliminarily tested with positive feedback. Three modules were designed and presented, including symptom management (cancer-related fatigue, cough, dyspnoea, pain, nausea and vomiting), emotion management and role management.

Conclusion: This study showed that patients with lung cancer have diversified supportive care needs after discharge. A bottom-up and stepwise approach to develop mobile health–based self-management support tool has shown to be feasible and valuable. Theory guidance, user requirement exploration, evidence-based information and expert evaluation are key elements of the process.

Implications for Practice: The WeChat Public Account "Symptom Self-Management" could be used as sustainable platform to support patients with lung cancer in dealing with common challenges. It provides professional information, self-assessment tools, self-management skills and peer-support platform. Information presented in both text and audio forms enables patients' easy access to the platform.

Xiaosha Ni and Yan Lou contributed equally to this work.

KEYWORDS
a mixed method, Lung cancer, mobile health, nursing, self-management support, supportive care, symptom management, WeChat public account

1 | INTRODUCTION

Lung cancer is the most prevalent cancer both in China and worldwide (Bray et al., 2018). Patients with lung cancer experience various symptoms, such as cough, dyspnoea, pain, fatigue and nausea (Brown et al., 2015; Maguire et al., 2013; Ni et al.,2020), have higher psychological concerns (Nishiura et al., 2015). The symptom burden and negative mood are important reasons for severe distress of patients with lung cancer, which may further weaken patients' immune system, influencing patients' adherence to treatment and rehabilitation intervention, and thereby affecting the recurrence, metastasis and deterioration of tumours (Lvy et al., 2017). Self-management plays a key part in managing symptoms, while studies have reported patients' unmet supportive care needs in taking this role (Brown et al., 2015; Maguire et al., 2013). Chinese patients with cancer and family members reported frustration in coping with challenges after discharge from hospital, such as lack of access to reliable information, insufficient care and inadequate psychosocial support (Liu & Li, 2007). Providing patients with information and support is important to improve their self-management and enhance quality of life, which has been supported by the evidence from lung transplant patients (Abasi et al., 2021).

Mobile health (mHealth) is the use of wireless technology to deliver health services and information in mobile communication devices such as smart phones and tablets (de la Torre-Díez et al., 2015). It has been increasingly used for self-management support intervention for its relatively low-cost, large-scale target population, more convenient access and personalized services (Kao & Liebovitz, 2017). In China, the number of mobile search users reached 986 million, and the utilization rate nearly reached 99.7% by December 2020 (China Internet Network Information Center, 2020). mHealth-based interventions have shown to be effectively reduce the stigma of patients with cancer and improve their treatment experience (Jansen et al., 2015). It also serves as an alternative approach to alleviate the problems of shortage of professionals and lag in information dissemination (Leykin et al., 2012).

2 | BACKGROUND

A few mHealth platforms have been developed for patients with lung cancer with different focus in recent years. Ciani et al. (2019) have developed a mobile application (LuCApp) for patients with metastatic lung cancer to monitor and manage symptoms and currently under trial in Italy. One strength of LuCApp is the trigger of clinicians' in-time feedback when patients' self-reporting symptoms reaches at the alerting level. While acknowledging the importance in having healthcare workers available for patients with metastatic cancer, the sustainability of the service would be challenging for long-term cancer survivors when there is a shortage of healthcare professionals. Henshall and Davey (2020) in the United Kingdom developed iEXHALE to increase lung cancer survivors' exercise activity and to improve symptoms of breathlessness, fatigue and depression, and the usability study has shown its value in supporting self-management. Ji et al.'s (2019) mobile health–based pulmonary rehabilitation trial in Korea mainly applied the exercise intervention among early and advanced patients with lung cancer, reported improvement in dyspnoea after 12 weeks. Differently, Park et al.'s (2019) app-based program, which had pulmonary rehabilitation combined with exercise intervention and symptom management information, did not find statistically significant improvement in dyspnoea among advanced lung cancer undergoing chemotherapy. These findings indicated that patients with lung cancer at early and advanced stage may require a different regimen of exercise intervention to manage dyspnoea effectively. Alternatively, it may indicate that mHealth-based interventions should be tailored to cultural background.

While mHealth is a viable approach to support patients with lung cancer, as other interventions, it should be culturally sensitive and involving targeting user in the development process (Owens et al., 2020). However, only a few mHealth studies have described the developmental steps of platforms in detail (Whittaker et al., 2012), and current health apps have also been criticized for limited evidence-based support (Kao & Liebovitz, 2017; Odeh et al., 2015). How mHealth can be best used to support self-management of patients with lung cancer? What kind of information should be included to empower self-management of patients with lung cancer? These are two key research questions to be addressed in the current study.

The diffusion of innovation (DOI) theory provided guidance in developing the mHealth-based self-management support modules of patients with lung cancer. DOI, which was proposed by Rogers in 1983, contended that the diffusion of new product or technology was influenced by its five major characteristics: ① compatibility: the matching degree between the new product or technology and the potential users' values, requirement and current resource; ② complexity: the level of difficulty the potential users may have in learning about and using the new product; ③ superiority: the new product's advantage in either of economics, effectiveness, time-saving or comfort feeling; ④ testability: the possibility to test the new product or technology among a small-size sample with a low cost; and ⑤ observability: the perceptible effectiveness after using the new product and it could be shared with others in oral, written or figure forms (Everett & Rogers, 2003). To vitalize these traits, evidence, potential users and experts should be involved in developing new product. Detailed consideration is illustrated in the research design part.

In designing the delivery approach for modules, self-efficacy theory serves as the guidance. Self-efficacy is the belief that a person successfully implements and completes a certain behavioural goal

or ability to cope with a certain difficult situation, and four sources of efficacy beliefs are performance accomplishments, vicarious experience, verbal persuasion and emotional and physiological states (Bandura, 1977). According to the self-efficacy theory, self-efficacy beliefs influence the self-management by the degree of effort people may exert to the behaviours and the perseverance of behaviour in the face of obstacles (Bandura, 1977). The current study aimed to improve patients' self-efficacy mainly through information provision, interactive feedback and self-monitoring, thereby enhancing their self-management (Dickinson et al., 2014; Odeh et al., 2015).

3 | THE STUDY

3.1 | Aim

The aim of the study was to construct self-management support modules for patients with lung cancer and to design and preliminarily evaluate the mHealth platform to present these modules.

3.2 | Design

A multistep research with three phases was applied to develop "mobile-based lung cancer patient self-management support modules" (See Figure 1). DOI theory provided theoretical framework for the use of different methods. To achieve compatibility and superiority of the mHealth-based self-management support for patients with lung cancer, literature review on the supportive care needs of patients with lung cancer, qualitative study exploring user requirement and expert evaluation about the scientificity of modules were designed. To make the complexity acceptable, the design process is based on user requirement and the iterative interaction between the researcher and software designer. A small sample utility test with both objective and subjective evaluation was designed to reflect the testability and observability of the product. Ethics approval was obtained from the Scientific Research Ethics Committee of the Hangzhou Normal University (2,017,005).

3.3 | Data collection and analysis

3.3.1 | Literature review

The first literature review aimed to construct framework for self-management tools for patients with lung cancer. Studies exploring supportive care for patients with lung cancer were included, either survey, semistructured interview or intervention studies. The following databases were searched from 1 January 2000 to 1 February 2019: MEDLINE (via PubMed), Cochrane CENTARL, EBSCO, ScienceDirect, Wanfang Data (Chinese, 万方), VIP(Chinese, 维普网) and CNKI (China National Knowledge Infrastructure, Chinese, 知网). The search terms included "lung cancer," "lung neoplasm," "pulmonary neoplasms," "pulmonary cancer," "lung tumor," "lung carcinoma," "cancer of lung" and "supportive care," "support care," "supportive care needs," "肺癌,""肺肿瘤," "延续性护理" and "需求." In total, 17 studies were included, with 12 cross-sectional surveys and 5 qualitative studies (see Figure 2).

The second literature review was to develop detailed content for each module. The most recent guidelines for different symptoms

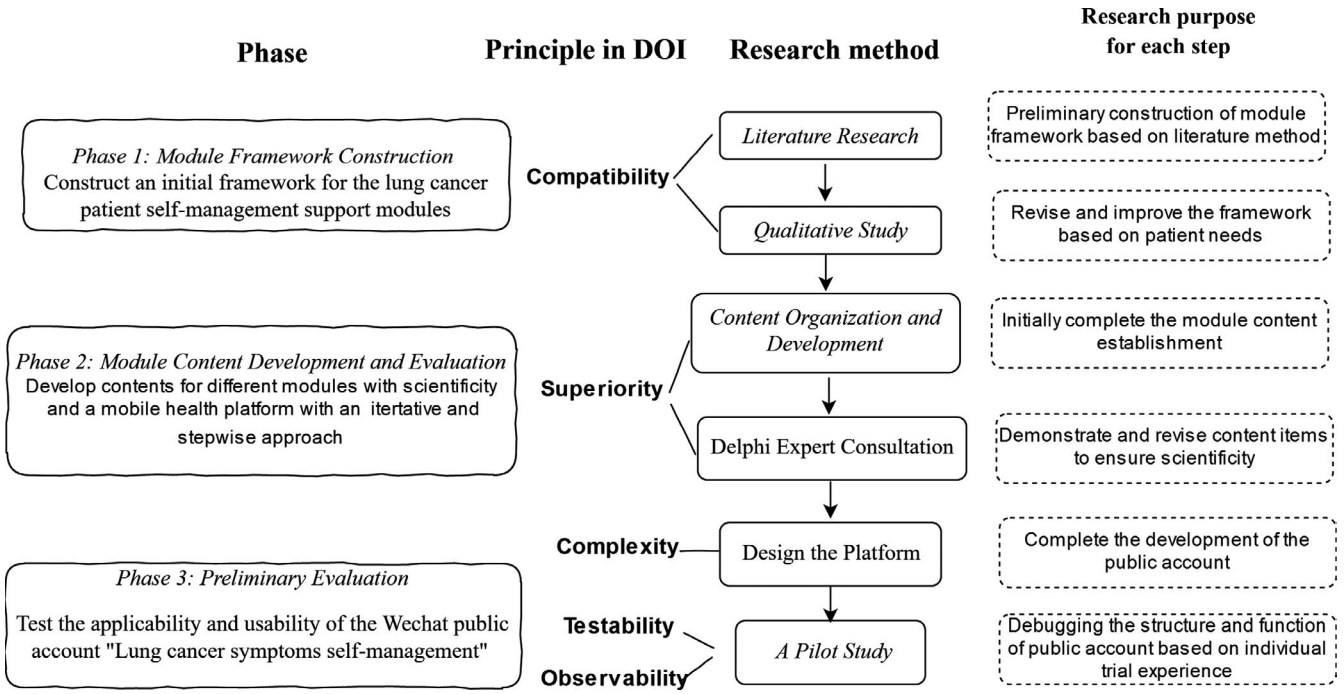


FIGURE 1 Development Process of the Mobile Health Platform

were used as the main basis, supplemented by high-quality study, textbooks and authority site.

3.3.2 | Semistructured interview

Participants were recruited from the lung cancer outpatient department in Zhejiang Cancer Hospital in China during May-June 2018. The inclusion criteria for patients were: (1) lung cancer diagnosis; (2) be 18 years of age or older; (3) experiencing physical symptoms, psychology concern or role conflict associated with disease and treatment; (4) use mobile devices independently (such as smart phone and iPAD); (5) physically able to take part in the study, Karnofsky performance status (KPS) ≥60); and (6) be voluntary to participate in the study by signing informed consent form. Exclusion criteria (1) with concurrent life-threatening diseases (2) have cognitive impairment and mental illness.

Interview outline included: *(1) what are the main problems you face during the rehabilitation process after discharge; (2) how did you deal with this problem currently; (3) what kind of support do you need to help you better cope with this problem; (4) What is your preferences for mobile health platforms*. The interviews lasted for 25–45 min and were recorded with participants' consent.

Data were transcribed in 12 hr after the interviews. The NVivo 11.0 software was used for coding and analysis of the data. Traditional content analysis method was applied (Zhou, 2017). Two researchers firstly read the transcribed text several times repeatedly to obtain a sense of the whole and then highlighted the text related to the supportive care needs of patients with lung cancer and made notes for similar concepts, constituting the unit of analysis. During this process, the researchers condensed units, abstracted the meaning and labelled different codes. Afterwards, codes were compared and grouped into categories. Lastly, tentative categories were discussed among research team to formulate main themes.

3.3.3 | Delphi study

The contents of all modules were further developed upon literature review. The structure and contents of modules were presented as different levels of indicators for expert review, including 8 level-one indicators (the types of modules), 34 level-two indicators (the themes in each module) and 157 level-three indicators (the detailed content for each theme). A modified, two-round Delphi consensus study was performed to evaluate the scientificity and practicability of modules (Hasson et al., 2000). The selection criteria for experts were (1) professional background: with expertise in the module content, including oncology nurses, oncology physicians, oncology nursing researcher, pain management specialist, traditional Chinese medicine clinician and psychiatrist with expertise in behavioural cognitive therapy; (2) academic qualifications and titles: bachelor for nurses and master for doctors, higher than intermediate title; (3)working experience: ≧10 years; (4) knowledge on symptoms: be familiar with the selected symptom; and (5) be willing to participate in the study.

The instruments consisted of a cover letter, expert information form, self-evaluation form on the familiarity with the topic and judgement basis, and indicator evaluation questionnaire. Experts were asked to rate the importance and feasibility of each topic on a Likert scale ranging from 1(not important at all) to 5 (extremely important) and were encouraged to make specific comments to justify their quantitative response.

Data were analyzed using the SPSS for Windows 20.0 software. Expert positive coefficient, expert authority coefficient, coefficient of variation and Kendall were used to assess the enthusiasm, authority and level of coordination of experts respectively. Each indicator was evaluated with the level of importance and feasibility, with mean score (X) ≥ 3.50 and coefficient of variation (CV) ≤0.25 as criteria for the retainment of the indicator (Chen, 2004).

3.3.4 | WeChat platform development

To construct an easy-to-access and practical platform for patients with lung cancer, user requirement analysis was conducted before the design. Following preference of patients with lung cancer, a service public account, which allows for the customization of the menu in the public account, was registered on the most popular social network in China, i.e. WeChat. It is owned by Chinese tech giant Tencent and is one of the main ways people communicate in China, which has monthly user base of more than 1 billion people. WeChat is a multiple function app, such as messaging and calling, moments (showcase daily life with texts, pictures and videos), public accounts (Government organizations, companies or groups could register and send articles and messages to their followers), payments and shopping.

Following the naming rules of the WeChat public account, the platform was named as “Symptom Self-Management.” In collaboration with software designers, iterative process was performed to develop the content and form of public account. Specifically, the platform considered the following aspects to enhance patients' self-efficacy. Firstly, the self-management support tool provided patients with self-assessment forms, enabling them to self-monitor the effect of self-management, which could help them to enhance their confidence in disease self-management through personal experience. Secondly, the platform set up an interactive section to facilitate communication among patients, which promotes patients' acquisition of indirect experience related to disease management or positive behaviours. Thirdly, health education is integrated in each module, helping patients to increase their confidence in self-management by easy access to professional knowledge. Lastly, there was interaction section between the patient and researcher to alleviate possible frustration in using the platform. Furthermore, an emotional management module was set up to help patients with lung cancer to understand their emotional status and take feasible psychological self-management strategies.

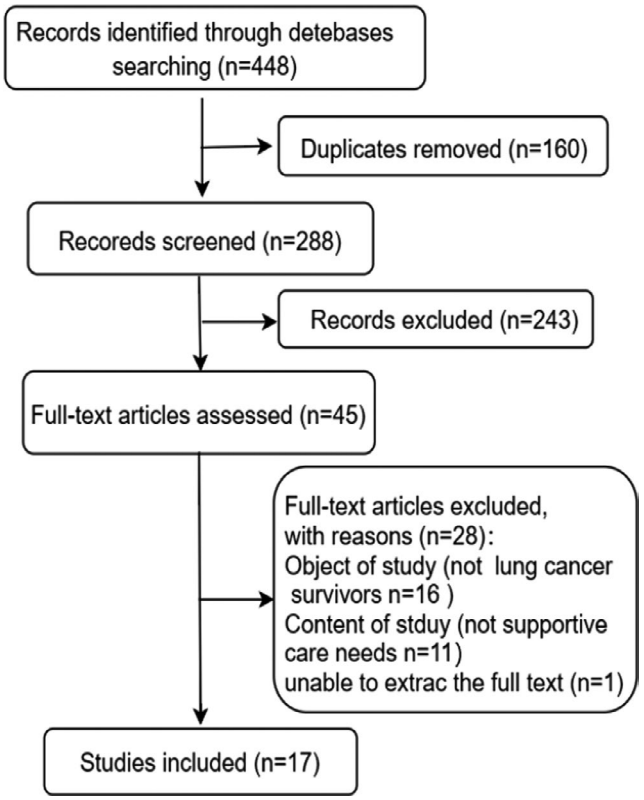


FIGURE 2 Flowchart of Review Process

3.3.5 | Preliminary evaluation study

Participants were recruited during January-February 2019. The inclusion and exclusion criteria, and recruitment site of the participants were the same as those in qualitative study. Participants were oriented to use the WeChat public account on their mobile phone by researcher on site with the help of printed brochure of the platform. Further person-to-person remote guidance was delivered as required. During the two-week testing period, participants were reminded and instructed to visit the WeChat public account 1–2 times per day, 3–5 days per week, and were invited to provide feedback. The researcher collected the user experience feedback with a self-designed questionnaire consisting of six closed questions (including module selection, comprehensiveness of module content, acceptance of the platform, easy understanding of the content, benefit and willingness to use the platform) and two open questions (① Please talk about your feelings after using the platform or whether there are any questions or difficulties in use? ② Do you have any other suggestions or comments to improve the platform?) via telephone interviews. The system tracked the users' frequency of accessing and browsing the public account.

3.4 | Rigour of the study

Theory guidance, user requirement exploration, evidenced-based information and experts' evaluation are key elements for the development of Symptom Self-Management WeChat Public Account. Strict inclusion and exclusion criteria have been applied to ensure high-level evidence from literature. Preinterview has been conducted to improve the outline of semistructured interview. After interview, two researchers used the multicrossing method to transcribe and code data. A field-representative expert team was invited to provide scientific suggestions. During the pilot test, both in-person and remote guidance were provided to promote compliance.

4 | RESULTS

4.1 | Phase one: Framework for self-management support modules of patients with lung cancer

4.1.1 | Literature review

The literature review resulted in a preliminary framework for supportive care modules of patients with lung cancer, mainly including *symptoms management*, *psychological support*, *social support*, *information support and role adaptation support*.

4.1.2 | Semistructured interview

A total of 15 patients with lung cancer were recruited for qualitative study when reaching data saturation. The age ranged from 45–76 years (62 ± 9.42), with the majority of them were male (67%), having a high school education or above (67%).

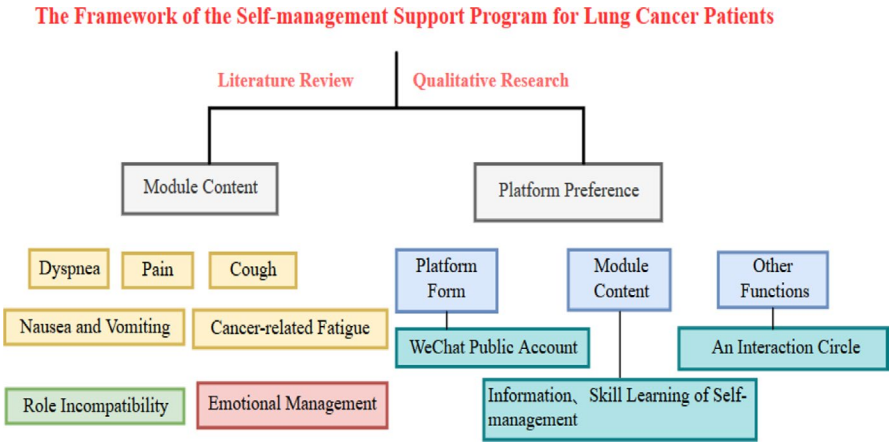
The qualitative finding informed a modified version of module framework. The results of semistructured interview revealed themes of insufficient professional support, lack of symptom management knowledge and skill, which further confirmed the necessity to include symptom management module. Furthermore, participants expressed difficulty in adjusting to the new role of patients with cancer for the reason of emotional frustration and family role; emotional and role support modules were thus designed (See Table 1).

Based on the results of qualitative research, the framework of "the Self-management Support Program for Lung Cancer Patients" was revised. Firstly, five preliminary modules were merged into three modules (information module was deleted, as disease and symptom information were elaborated in the symptom management module; psychological support and social support were jointly presented in the emotion module). Meanwhile, a peer-support module was added. Secondly, symptom management modules mainly include the most bothering symptoms reported by patients with lung cancer, i.e. dyspnoea, cough, pain, cancer-related fatigue and nausea and vomiting. Thirdly, for each module, it was suggested to include both information and symptom management skill development. Lastly, as preferred by participants, WeChat public account was chosen to be the mHealth platform to present all modules (See Figure 3).

TABLE 1 Modified Module Framework Informed with Qualitative Research Findings

Themes	Subtopic	Quotes example	Clues for Module Framework
1. Insufficient Professional Support	(1) High demand for professional information support	*"We don't know doctors in private, there is no way to communicate with them."*	Set up symptom management and provide with professional information
	(2) Insufficient access to professional information	*"But the doctors are always busy and don't have time to talk to us… I don't think the doctors are helpful enough."*	
2. Lack of Skills in Symptom Management	(1) Lack of relevant skills	*"There is no other way (to deal with shortness of breath). Anyway, I have been in the hospital anyway."*	
	(2) Negative treatment in diseasemanagement	*"I have been bedridden at home… I haven't asked for help and I don't know what to do."*	
3. Inadequate Self-adjustment with Emotional Fluctuations		*"I have much pressure in my mind, and I am not willing to communicate with others"* *"I will deliberately reduce contact with others after I am sick."*	Set up emotional management of psychological distress as the main content
4. Reliance on and Concern with Family Support	(1) Prone to excessive family protection	*"My family are afraid I'm too tired, so they won't let me work."*	Set up social support with role adaptation as the main content
	(2) Concerns about family care	*"They are very busy at work, and we shouldn't bother them."*	
5. Limited Access to Peer Support		*"I communicated with them (peer) in hospital, but after being discharged not." "I don't have communication with other patients, i am the only patient in our village."*	Set up a patient interaction circle to provide with peer support
6. Preference for a Health Mobile Platform	(1) Relevance of platform content	*"Of course, I prefer a platform that is more convenient to use and easier to operate."*	Be presented in the form of WeChat public account platform
	(2) Platform ease of operation	*"I usually don't play much on smart phones, so I don't know how to operate."*	

FIGURE 3 The Framework of the Self-management Support of Program for Lung Cancer patients



4.2 | Phase two: Design and content development of the WeChat public account

4.2.1 | Content development

Based on the framework of "the Self-management Support Program for Lung Cancer Patients," use the literature review to construct the content of each module preliminary. Information sources include authoritative guides, high-quality researches, medical websites, books, etc (See Table 2).

4.2.2 | Content expert review

A total of 13 experts from tertiary hospitals and nursing education in medical colleges were included with a 100% compliance rate. In the first round, 66% indicators were valued at least as moderately important by all experts (4 or higher on the Likert scale). A total of 4 level-one indicators and 4 level-two indicators were modified, 15 level-three indicators were deleted and 32 level-three indicators were added. In the second round, 95% indicators were valued at least as moderately important by all experts, in which 1 level-one indicator was added, 3

TABLE 2 Reference for the Development of Module Content

Modules	Guidelines	Literature (for example)	Textbooks	Websites
Dyspnoea	1.《2017 Small-Cell Lung Cancer NCCN Guidelines》 2.《2018 NCCN Cancer Survivor Guidelines》;	1. Changgui L, Zeyun Z, Li B. Progress in the improvement of dyspnea in patients with lung cancer. *Chinese Journal of Lung Diseases (Electronic Edition)*.2016,9(5): 565–568. (in Chinese) 2. Ran W, Yanan Z. Effect of comprehensive nursing intervention on dyspnea among lung patients with cancer during perioperative period. *Chinese Journal of Maternal and Child Health*, 2017; (A1): 398–399. (in Chinese) 3. Jantarakupt P, Porock D. Dyspnea management in lung cancer: Applying the evidence from chronic obstructive pulmonary disease. *Oncology Nursing Forum*. 2005; 32(4): 785–795.	1. Hengzhi Z, Jin L. *Self-management of common chronic diseases*. Beijing: tsinghua university press, 2015. 2. Pingping L. H*andbook of TCM and Western Medicine Treatment of Common Tumor Symptoms*. Beijing: China Press of Traditional Chinese Medicine, 2015. 3. Aihua H, et al. *Treatment and nursing of common tumors*. Qingdao: China Ocean University press, 2010.	*Chinese website:* *DXY*: http://www.dxy.cn/. *Medlive:* http://www.medlive.cn/. *Websites in Australia:* http://cancerlearning.gov.au/https://www.cancer.org.au/. *American Cancer Society website*: https://www.cancer.org/treatment/treatments-and-side-effects/physical-side-effects/pain/non-medical-treatments-for-cancer-pain.html https://wiki.cancer.org.au/australia/Guidelines: Cancer_ pain_management/Flowchart_overview
Cough	1.《2018 CHEST Guidelines: Treatment of lung cancer-related cough》 2.《2017 CHEST Guidelines: Classification and management of cough symptoms in adults》	1. Molassiotis A, Smith JA, Mazzone P, et al. Symptomatic treatment of cough among adult patients with lung cancer. CHEST Guideline and Expert Panel Report. *Chest* 0.2017; 151(4): 861–874. 2. Perotin JM, Launois C, Dewolf M, et al. Managing patients with chronic cough: challenges and solutions. *Therapeutics and Clinical Risk Management*. 2018;14:1041–1051. 3. Sarah C, Rachel G, Surinder SB. Cough suppression therapy. Does it work? *Pulmonary Pharmacology &Therapeutics*. 2013; 26(5): 524–527. 4. Li H. Advances in cough management in patients with lung cancer. *Drug & Human*, 2014; 27(7): 41. (in Chinese). Etc.		
Pain	1.《2017 Shanghai Expert Consensus on the Diagnosis and Treatment of Cancer Pain (2017)》 2.《2018 NCCN Adult Pain Guidelines》	1. Mercadante S, Vitrano V. Pain in patients with lung cancer: Pathophysiology and treatment. *Lung Cancer*. 2010; 68(1): 10–15. 2. Imani F, Rahimzadeh P. Interventional pain management according to evidence-based medicine. *Anesthesiology and Pain Medicine*. 2012;1(4): 235–2363. 3. Hongmei H, Advanced lung cancer pain control and nursing progress, *Chinese Journal of practical nursing*. 2013; 29(22). (in Chinese) 4. Hu X. Research progress of pain care for patients with lung cancer. *Special Health*, 2014; 7:703–704. (in Chinese)	1. Li L. *Handbook of Pain Care*. Chengdu: Sichuan University Press, 2013. (in Chinese) 2. Jingxi Z. *Practical Handbook of Diagnosis and Treatment of Acute Lung Cancer*. Shanghai: the Second Military Medical University Press, 2013.	

(continues)

TABLE 2 (Continued)

Modules	Guidelines	Literature (for example)	Textbooks	Websites
Cancer-related fatigue	1.《2018 NCCN guidelines for cancer-related fatigue》 2.《2014 American Society of Oncology Guidelines on Nutrition and Exercise for Cancer Prevention》	1. Mohandas H, Jaganathan, SK, Mani MP, et al. Cancer-related fatigue treatment: An overview. *Journal Of Cancer Research and Therapeutics*. 2017; 13(6): 916–929. 2. Du, SZ, Hu, LL, Dong, JS, et al. Patient education programs for cancer-related fatigue: A systematic review. *Patient Education and Counseling*. 2015; 98(11): 1308–1319. 3. Qi W, Qiuqiang C, Jiantong S, et al. Systematic evaluation of effect of exercise intervention on cancer-related fatigue in patients with lung cancer. *Chinese Evidence-based Nursing*. 2018; 4(1): 1–5. (in Chinese) 4. Yixun T, Yunlan J, Yixian L, et al. Current status of exercise therapy in patients with cancer-related fatigue. *China Convalescent Medicine*, 2017; 26(1):24–27. (in Chinese)	1. Denghai M. *Cancer-related fatigue*. Beijing: People's Medical Publishing House. 2013. 2. Tina M. St. John, *With every breath: a lung cancer guidebook*. 1st ed. Australian *Government and Australian* Sports Medicine Association; 2003.	
Nausea and vomiting	1.《2016 MASCC/ESMO Guidelines: Nausea and vomiting related radiotherapy and chemotherapy and the prevention of nausea and vomiting in patients with advanced tumor》 2.《2014 Chinese Guidelines on the Prevention and Treatment of Oncology Therapy Related Vomiting》	1. Liping Z. Prevention and nursing care of nausea and vomiting in patients with lung cancer during chemotherapy. *Journal of Clinical Pulmonary Medicine*. 2007; 12(3): 310. (in Chinese) 2. Dan L, Yuwei W, Huaping L, Effects of relaxation training on acute and delayed nausea and vomiting induced by cisplatin in patients with lung cancer. *Journal of Nursing Science*, 2016; 31(11): 29–31. (in Chinese) 3. Navari RM. Managing Nausea and Vomiting in Patients with Cancer: What Works. *Oncology*. 2013; 32(3): 121–125,131,136.	1. Yang Y, Shiying Y. *Nausea and vomiting induced by antitumor therapy: a self-management handbook*. Beijing: Peking Union Medical College Press, 2017. 2. Yanzhi F, Yufeng T, Xinhua X. *Oncology chemotherapy nursing*. Beijing: People's Military Medical Press, 2015.	
Psychological distress	1.《2017 NCCN Clinical Practice Guidelines: Management of psychological pain》 2.《2014 American society of oncology guidelines on nutrition and exercise for cancer prevention》	1. Lehto RH. Psycho-social challenges for patients with advanced lung cancer: intervention to improve well-being. *Lung Cancer: Targets and Therapy*. 2017; 8:79–90. 2. Wang B. Hao *N*, Zhang X. Factors influencing the psychology and quality of life in lung cancer patients. *Saudimedical journal*. 2017; 38(9): 948–951. 3. Jianxia L, Jing G, Chenxi W, et al. Research Progress of Psychological Pain in Lung Cancer Patients. *Journal of Medicine and Philosophy*. 2017; 38(11B): 61–65. 4. Xiaohuan H, Dan L, Yue C, et al. The effect of NCCN on the quality of life in patients with lung cancer. *International Journal of Psychiatry*. 2016; 3:555–558, 562.	1. Lili T, Jianping W. *Psychosocial Oncology*. 2012 2. Tina M. St. Joln. With Every Breath: A Lung Cancer guidebook. Australian Government and Australian Sports Medicine Association. November. 2003	

(continues)

TABLE 2 (Continued)

Modules	Guidelines	Literature (for example)	Textbooks	Websites
Role management		1. Sherry V, Guerra C, Ranganathan A, et al. Metastatic Lung Cancer and Distress: Use of the Distress Thermometer for Patient Assessment. *Cin J Oncol Nurs*. 2017; 21(3): 379–383. 2. Hongai W, Fenglin C, Jie L, et al. The Relationship between positive psychological character, social support and quality of life in lung cancer patients. *Journal of Nursing*, 2015; 30(17): 23–25. 3. Rujuan Y, Hong N, Dexiang W, Ping Z. Nursing care for maladaptive role in patients with advanced cancer. *Journal of Applied Clinical Medicine*. 2000; 5(4): 13–14.	1. Fengrong W. *Nursing Psychology*. Peking University Medical Press. 2013 2. Aiguo Z, Mingbo W, Jichong Z. *Medical Psychology*. Shandong People's Publishing House. 2009.	

level-three indicators were modified and 6 level-three indicators were deleted. Finally, a total of 168 indicators were finalized.

4.2.3 | WeChat public account design

Considering conveniences and restrictions of the WeChat service platform used in this study, similar content materials were grouped together under main category. In the user interface, there are three main menus or tabs (symptom management, role management and emotion management, and mine) (See Figure 4).

Under the symptom management, role and emotion management tabs, there are 11 secondary menus. For each secondary menu, there are four sections: ① Self-Assessment: this section helps patients to assess the level of problem or symptoms with corresponding scales, serving as self-monitoring tool. It can be evaluated according to patients' needs or be evaluated monthly after application of this module. ② Relevant Information: this section provides information about the symptom or problems, including the definition, mechanism, influencing factors, pharmacological and nonpharmacological interventions, aiming to reduce patients' misunderstanding and uncertainty in response to cancer. ③ Self-management Strategy: this section is key in the module for skill enhancement, providing easy and evidence-based self-management strategies for patients to learn in the form of audio, graphic and video. ④ User Feedback: this section asks patients to evaluate the module from the perspective of accessing frequency, subjective experience and suggestions, helping to further improve the module. A combination of text, images and audio were used to present information for each part (See Figure 3).

In the third main menu-"Mine," there are four submenus with different functions. In *Registration tab*, patients need to register and log in when they use the platform for the first time with WeChat authorization via mobile phone or computer. In *Interaction tab*, patients can post and browse posts, or communicate about experiences in disease management. In *Help tab*, a platform user guideline was designed, illustrating the function and content of each module and the operating procedure. The reason to include this part is in considering the age characteristics of patients with lung cancer, most of whom are ageing people. In *Survey tab*, we set out survey questionnaires, including demographic information, quality of life and self-management self-efficacy questionnaire. In addition, the platform has other features including keyword searching, message and comment, and collection.

4.3 | Phase three: Pilot test

A total of 13 lung patients took part in the testing of the WeChat public account on acceptability and feasibility. The majority of participants were male (76.9%), diagnosed disease in 2 years (92.3%) and had education background with primary school at least (84.6%). Participants' age ranged from 45–75 years (58.8 ± 8.0).

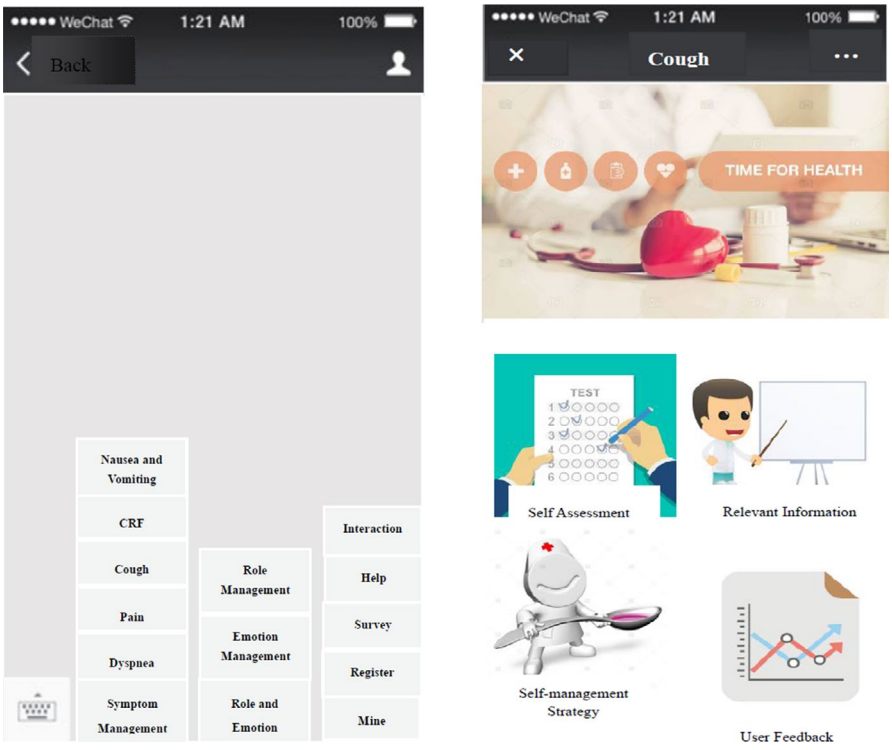


FIGURE 4 The Interface of the Public Account "Symptom Self-Management"

According to the Log Data, there was no software failure recorded during the 2-week testing, indicating the stability of the system. There were 60 pages in public account, and patients accessed them 670 times in 2 weeks in total, i.e. 26 times per week. The dyspnoea and cough modules were mostly used, followed by cancer-related fatigue, pain, emotional management, nausea and vomiting, and role management in order. Top ten viewed pages mainly focussed on symptom management including dyspnoea, cough, cancer-related fatigue and pain modules, especially Relevant Information and Self-management Strategy modules in each module (See Table 3).

With regard to user feedback, all participants perceived the public account to be helpful. Most patients (n = 10) found the contents of the public account modules to be comprehensive and easy to understand, and they were willing to use it further. All participants appraised the interface of the public number to be clear and friendly, and the dubbing was pleasant and very helpful. After the use of the "symptom self-management public account," participants reported that they feel more confident in implementing strategies to deal with common symptoms and other challenges. Furthermore, participants reported they felt less social isolation as this platform enabled more support from other people with similar challenges.

5 | DISCUSSION

Patients with cancer are a special population requires on-going support. Relative to other patients with cancer, patients with lung cancer are even more special for the reason of higher prevalence, repeated treatment, poor diagnosis, and more physical symptoms and psychological distress (Li & Girgis, 2006). The current study developed a WeChat public account "symptom self-management" for patients with lung cancer with a stepwise approach. It aimed to provide patients with lung cancer with a reliable and evidence-based tool to support their self-management in facing with commonly experienced symptoms and challenges.

5.1 | The compatibility and superiority of self-management support modules

The current study endeavoured to reach the compatibility of the self-support modules through evidence-searching, user requirement research and expert evaluation. In doing so, the most common symptom patients with lung cancer experiencing were included, i.e. cancer-induced fatigue, cough, dyspnoea, pain, nausea and vomiting, as well as two modules of emotion management and role management to meet psychological needs and interactive section to get peer support. To achieve individualized support, self-assessment session was set for each module, enabling patients to assess the effect of self-management dynamically. Both basic knowledge and skills were presented in each module, helping patients to know about the problem and practice the management of the problem.

Different from Ciani et al.'s (2019) LuCApp, Hanshall and Davey's (2020) iEXHALE, which were both apps, our current WeChat self-management support tool is based on social network platform. As informed by the semistructured interview, Chinese patients with lung cancer preferred the use of WeChat public account as platform for self-management support modules for the reason of convenience and the reduction in amount of data. WeChat is the most popular

TABLE 3 Top Ten Mostly Browsed Pages in the "Symptom Self-Management" Modules

Rank	Page Title	Browse Frequency	Module
1	What is dyspnea?	76	Dyspnea-Relevant Information
2	How to deal with dyspnea?	62	Dyspnea-Relevant Information
3	Respiratory muscle function training	41	Dyspnea-Self-management Strategy
4	What is the impact of dyspnea?	39	Dyspnea-Relevant Information
5	Relaxation training	35	Dyspnea-Self-management Strategy
6	Cough suppression therapy	34	Cough-Self-management Strategy
7	How to deal with cough?	30	Cough-Relevant Information
8	How to deal with CRF?	30	CRF-Relevant Information
9	What is the impact of cough?	27	Cough-Relevant Information
10	Analgesic-drug specification guide	27	Pain-Self-management Strategy

messaging and calling app used in China, with more than 1.1 billion users. WeChat public account is a platform that allows WeChat followers to access information and services through an official account, and it has no special requirement for the mobile operating system.

With regard to the content, while LuCApp was mainly on symptom monitoring and iEXHALE and pulmonary rehabilitation programs were exercise focussed (Bray et al., 2018; Henshall & Davey, 2020; Park et al., 2019), the content included in the "symptom self-management" public account was more broad with knowledge dissemination and skills teaching in managing symptoms, role and emotion challenges that had been consistently reported in previous studies as unmet supportive care needs by patients with lung cancer (Brown et al., 2015; Husain et al., 2013; Li & Girgis, 2006; Sanders et al., 2010). The emphasis on self-management support of the current study was consistent with Salvador Vergès et al., (2021) notion, who designed WeChat platform-based "lung cancer forum" supporting postoperative patients with lung cancer after chemotherapy. While Salvador Vergès et al., (2021) reported the effect in improving patients' sleep quality, health performance and self-perceived burden, the development process of the forum content was more up-to-down approach, different from the current study's bottom-up process.

5.2 | The testability, observability and complexity of mobile health platform

According to the principle of testability and observability of DOI, a small sample test with both subjective and objective evaluation of the public account was conducted with the newly developed platform, which is a necessary step before conducting RCT (Whittaker et al., 2012). By doing these, the complexity of the public account could be assessed, and the user-friendliness could be enhanced by eliminating faults.

The feasibility study indicated that participants evaluated the WeChat account in a positive way, rating the platform easy-to-use, and as acceptable, the content was comprehensive and understandable. To make the interface of the public account more friendly, we designed user guideline and had professional voice broadcasting of contents in each module. These considerations were to support self-management if the user encounters difficulties in memory and reading. While most participants replied that the public account was friendly with big-font text and audio assistance, some participants expressed needs for more person-to-person guidance in accessing these modules. These feedback indicated that the mHealth itself could benefit most, but certain in-person assistance was still in need to support self-management. The notion of combining the mHeath and face-to-face contact has also been illustrated in palliative care settings (Salvador Vergès et al., 2021).

Interestingly, the assessment form in the current study was not used frequently by participants. It seems that most patients seldom consciously evaluate their symptoms. Self-management requires individuals to use self-regulation skills and perform activities like goals setting, self-monitoring and decision-making (Ryan & Sawin, 2009). From this perspective, more efforts should be put to improve self-monitoring. For those having done, the assessment indicated that the platform did not provide instant feedback and the assessment form itself is not easy to operate. While the public account has its limitation in real-time interaction between the user and system, app could be option to improve the function. In terms of the assessment form, audio instruction may be required to support the access.

When reviewing the using frequency of different modules, it was found that symptom modules were more frequently accessed than role and emotional management modules. This outcome is consistent with our team's previous finding that individual's information demands influence the mHealth information seeking behaviour (Hu, 2018). Particularly, dyspnoea and cough modules were mostly accessed, suggesting more supports are required for patients with lung cancer to manage these symptoms.

Furthermore, participants expressed requirement for regular information update. On one hand, some participants indicated that fixed contents may cause a lack of freshness. To make the module content more attractive, the new information is as important as the tested evidence. On the other hand, some patients expressed their

desire for support on other symptoms, such as insomnia, which was quite common among them.

6 | LIMITATIONS

This study has a few limitations. Firstly, although the public account is easy-to-access, there are limited functions of the platform. For example, the platform could not give interactive feedback to the patients' symptom self-assessment result. Future research needs to consider improving the platform's effectiveness evaluation and achieving intelligent feedback to enhance users' motivation in accessing the platform. Secondly, this study provided on-scene instruction and electronic brochure in accessing the "symptom self-management" public account, but it did not take into consideration of the elder participants' need for further self-help assistance. Video instruction could be developed in the future for simplicity. Thirdly, the symptoms included in the study is based on literature review and the semistructured interview, and these are not adequate. Continuous update of the public account should be conducted to benefit more patients. Fourthly, we find patients' positive feedback over the public account and effectiveness in increasing self-efficacy. But it was conducted over a very short period of time with a small sample size. Further prospective study is required for the evaluation of long-term effects.

7 | CONCLUSION

This study showed that patients with lung cancer after discharge have diversified supportive care needs, especially professional information support need. They were also lack of self-management skills and a sustainable peer-support platform. Therefore, we used a stepwise and iterative approach to develop an evidence and theory-based WeChat public account promoting an active management of disease that was adapted to the specific needs and preferences of patients with lung cancer.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

XN, YL; Made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data. XN, YL, YZ, WH, HW, HX, SL, YN; Involved in drafting the manuscript or revising it critically for important intellectual content. XN, YL, YZ, WH, HW, HX, SL, YN; Given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. XN, YL; Agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

DATA AVAILABILITY STATEMENT

The data involved in this manuscript are available for share if necessary.

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