Perceptions of utilizing a symptom self-management app for breast cancer patients receiving outpatient chemotherapy

Abstract

Purpose

Breast cancer (BC) patients who are undergoing outpatient chemotherapy encounter difficulties in symptom self-management at home. We have developed a mobile app with the support of self-regulation activities and nurse-led social service to empower self-management of BC patients during outpatient chemotherapy. The study aimed to explore the perceptions of breast cancer patients and nurses in utilizing an app with the functions of proactive nursing support and empowerment.

Methods

This is a qualitative study including group interviews with nurses and patients with breast cancer receiving outpatient chemotherapy. A total of eleven patients and five nurses were enrolled from August 2022 to October 2022. Thematic analysis was adopted to analyze the interview transcripts. Main themes and related sub-themes were drawn from the transcripts.

Results

Barriers (the lack of a contractual spirit) and facilitators (social support and native high-adherence) to app usage were identified. Following the six-week program, patients underwent various transformations such as improved health awareness and a tendency to pay more attention

to psychological symptoms. This program also led to various changes in the nurses, including a transformation from taking the reactive emergency calls to a proactive approach of incorporating a self-regulation process and social support.

Conclusions

The findings from the group interviews stressed the importance of integrating technology and nursing social support in facilitating patient symptom self-management.

Introduction

Breast cancer (BC) is the most prevalent malignant tumor affecting females globally (Demirhan et al., 2020). An estimated 429,105 patients in China were newly diagnosed with BC in 2022, the equivalent of approximately 1180 cases every day (Siegel et al., 2023; Xia et al., 2022). While chemotherapy has been widely recognized as a first-line treatment for killing cancer cells, its toxic effects put BC patients at risk of experiencing a wide spectrum of side effects (Feliu et al., 2020; Partridge et al., 2001; Skerman et al., 2012). Nowadays, the common practice is for BC patients to receive chemotherapy in outpatient clinics. The arrangement is good for the patients because they will not need to be exposed for long in a bacteria-filled environment and can stay where they feel most comfortable after the treatment. However, this arrangement also limits the patients' chances of consulting healthcare professionals about the management of symptoms and side effects, which may put patients at a risk of experiencing symptom deterioration and lead to life-threatening situations, especially for those dwelling in remote rural areas.

The Chinese government has been actively promoting the delivery of transitional care services via mobile health (mHealth) for cancer patients undergoing ambulant chemotherapy in outpatient settings, in order to increase interactions between healthcare professionals and patients during the COVID-19 pandemic (Chinese State Council, 2022). mHealth is described as "the utilization of mobile apps to promote health-related behaviors and deliver timely and tailored healthcare for improving the health-related outcomes of an individual" (World Health Organization, 2011). As an important carrier of mHealth, mHealth applications (apps) have attracted increasing interest in the development of numerous transitional care programs to support self-management among cancer patients. The evidence has indicated that mHealth apps offer advantages such as real-time symptom tracking, instant feedback, and the provision of timely health information to patients (Charalambous A, 2019; Cruz et al., 2019; Lewis et al., 2016; Shi et al., 2023).

While studies have shown that using mHealth apps can have a positive effect on the health outcomes of cancer patients, the non-sustained use of such apps among this population remains one of the common issues that hindered its development. Evidence showed that the effectiveness of mHealth app-based intervention can be influenced by the proportion of patients who do not adhere to app usage (Donkin et al., 2011). Prior studies on mHealth app-based self-management generally reported a sharp decrease of 25.5% or even 50% in the rate of adherence to app usage among BC patients across the span of the intervention.13 Perceived lack of usefulness, inadequate social support, forgetfulness, and symptom distress were some of the reasons put forward to explain the low rate of compliance of BC patients in using these mHealth applications (Magalhães et al., 2020; Wong et al., 2022; Zhu et al., 2020). To fill this gap, our research team developed a nurse-led mHealth self-management program (mChemotherapy) (Shi et al., 2022). This program was guided by the Individual and Family Self-management Theory

(IFSMT) (Ryan and Sawin, 2009; Wong et al., 2015). A randomized controlled pilot study was conducted to evaluate the usability of the app, the feasibility of the intervention and preliminary effectiveness of this program.

This program had preliminary benefits in improving QoL, symptom burden, and healthcare utilization for BC patients undergoing chemotherapy. Nevertheless, the feasibility outcomes showed that the patients' rate of adherence to app usage was only 4.8% at week 3 and reached 51.2% at week 6. It was warranted to identify potential factors that might influence the patients' adherence to app usage. A qualitative study and a randomized controlled trial (RCT) conducted alongside each other have been viewed as trial-siblings that play a crucial role in the evaluation of complex interventions (Thiessen et al., 2022). The qualitative trial-siblings can lead to deeper explorations of the factors that challenge the implementation of the intervention (Thiessen et al., 2022). Therefore, a qualitative study was carried out with the aim of further understanding the factors related to the feasibility of the study and the patients' rate of adherence to app usage. The research questions were:

- Question 1: What are the facilitators to utilizing a symptom self-management app in breast cancer patients receiving outpatient chemotherapy?
- Question 2: What are the barriers to utilizing a symptom self-management app in breast cancer patients receiving outpatient chemotherapy?

Methods

This was a qualitative study conducted following a randomized controlled trial. The registration of this study has been posted on ClinicalTrials.gov since Jan 14, 2022 (NCT05192525). Three

group interviews were conducted after the completion of the intervention to evaluate the patients' and nurses' perceptions of engagement in the study. The open-ended questions were designed based on the conceptual framework (i.e., knowledge and beliefs, self-regulation skills and abilities, and social facilitation) as well as on the feasibility of guiding the semi-structured interview (Appendix 1). The reporting of the current study followed the Standards for Reporting Qualitative Research (SRQR)* (Appendix 2).

Participants and setting

A purposive sampling method was adopted to recruit participants. Recruitment was conducted in an outpatient chemotherapy ward of a medical hospital in Shanghai, China. Patients with BC who engaged in the intervention group and nurses who participated in the RCT were recruited. Four patients with BC declined to participate because they were not interested in joining.

The mChemotherapy app

Participants were trained to monitor symptoms themselves once per week by using the mChemotherapy app during the 6-week intervention. Six modules were integrated in the mChemotherapy app, namely: (i) self-monitoring, (ii) alerts, (iii) consultations, (iv) reminders, (v) my prescriptions, and (vi) knowledge base (Fig. 1). The app was built on an official WeChat platform of Ruijin Hospital, Shanghai Jiao Tong University School of Medicine. Patients in control group received routine care.

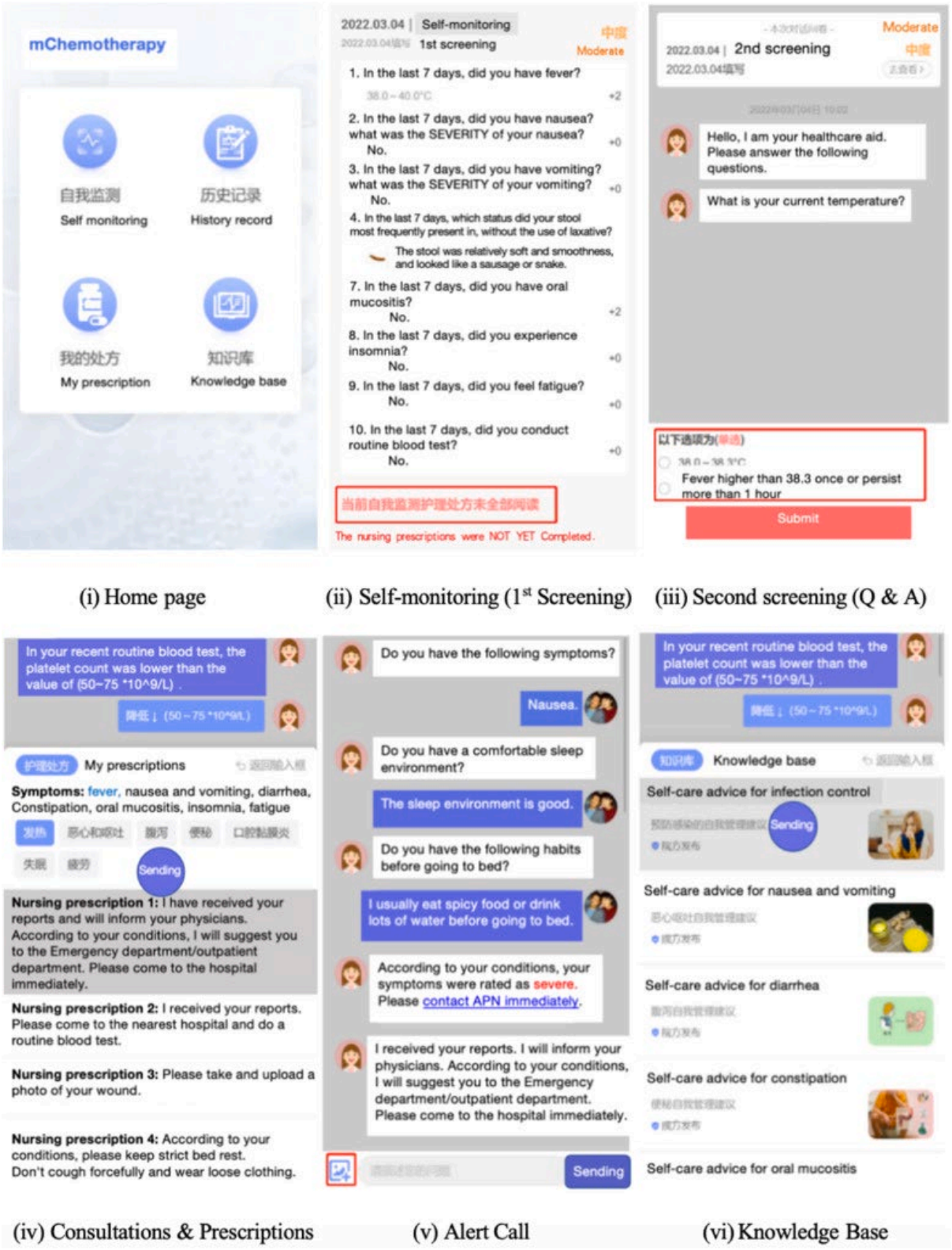

Fig. 1. Six modules of the mChemotherapy app (Shi et al., 2024).

Procedure

We carried out three cycles of recruitment, including five patients per cycle. Evidence indicated that participants might provide answers in accordance with what they believe the researchers (ie., nurses) may expect, rather than what they truly feel, which is referred to as "acquiescence (or condescending) bias" (Zini and Banfi, 2021). Accordingly, patients and nurses were assigned in different group interviews. Each of the group interviews was carried out via online meetings, and lasting 1∼1.5 h. The interview process involved seeking feedback on specific topics, such as overall experience in the RCT, evaluation of pre-chemotherapy consultation and follow-up visits, assessment of instruments/questionnaires used, evaluation of the mChemotherapy intervention, and identification of challenges and facilitators related to self-monitoring and self-management. Throughout the interview, the researcher asked clarifying and probing questions to delve deeper into participants' perspectives, ensuring an in-depth exploration and understanding of their experiences and perceptions. The transcript of each group interview was reviewed, and the frequency of new codes was counted for assessing the data saturation. The data reached saturation after three group interviews, when the number of new codes was under 5% (Hennink and Kaiser, 2022).

Data analysis

Interview transcripts were analyzed using thematic analysis. All of the group interviews were conducted in Mandarin Chinese. A qualitative analysis software (NVivo 12.0) was used to analyze the qualitative data. The audio and video data were recorded using a mobile phone and the video-recording function of Tencent Meeting, respectively. They were transcribed into text using the transcription software Xunfei. The transcripts of the group interviews were read a few times over by the doctoral student to check for errors in content generated by the automatic

transcription. The transcripts were imported into the data analysis software. The researchers utilized thematic analysis by assigning comparable codes to each theme that effectively capture essential information (Braun and Clarke, 2013). The contents of the transcripts were sorted into several predominant themes. Meaning units were extracted under each content theme and then condensed. The codes were labelled and abstracted from the condensed meaning units by two researchers. Various codes were sorted into sub-categories after they were compared for differences and similarities.

Rigor

Four aspects of quality criteria were checked according to the Practical guidance to qualitative research, including credibility, dependability & confirmability, reflexivity, and transferability (Korstjens and Moser, 2018). (1) Credibility: A professor was invited to act as the independent researcher in conducting a reliability check using Chohen's Kappa (McHugh ML, 2012; Odegard et al., 2022). The transcripts were translated and categorized into themes by two independent research team members (NS & XBL). Any discrepancies were reviewed and resolved in meetings to ensure consensus. (2) Dependability & Confirmability: The qualitative study was carried out following the protocol stringently and the whole process of group interviews was recorded by using Tencent Meeting. (3) Reflexivity: Throughout the process of collecting and analyzing the data, the interviewers needed to contemplate their prior encounters in oncology to ensure that they were vigilant against any potential biases that could sway their understanding of the findings (Kenis et al., 2022). (4) Transferability: The methodology of this qualitative study (ie., the study setting, sample, demographic data, and interview procedure) was clearly described for readers' transferability judgement.

Ethical considerations

The study was ethically approved by the Hong Kong Polytechnic University (HSEARS20210816002). All recruited patients received information about the program and their written informed consent was obtained prior to the collecting of baseline data.

Results

Characteristics of the participants

A total of eleven patients and five nurses participated in the post-intervention group interviews. The median age of the patients was 37 (range: 31–54) and their rate of adherence to app usage ranged from 16.7% to 100% at week 6. The nurses' median age was 38 (range: 27–42). Their demographic characteristics are given in Table 1, Table 2.

Table 1. Demographic characteristics of the patient-interviewees (N = 11).

Project ID	**Age**	**Sex**	**Education**	**Employment status**	**Marital status**	**Monthly family income**	**Care status**	**Chemotherapy scheme**	**Rate of adherence to app usage**
10	36	Female	Completed tertiary school	Full-time job	Married	3000–6000 RMB	Cared for by self	Neoadjuvant chemotherapy	33.3%

11	31	Female	Completed tertiary school	Full-time job	Married	6000–10,000 RMB	Cared for by parents	Neoadjuvant chemotherapy	50.0%
12	34	Female	Completed tertiary school	Full-time job	Married	>10,000 RMB	Cared for by parents	Neoadjuvant chemotherapy	16.7%
13	37	Female	Completed tertiary school	Unemployment	Unmarried	<3000 RMB	Cared for by parents	Adjuvant chemotherapy	66.7%
14	37	Female	Completed tertiary school	Part-time job	Married	>10,000 RMB	Cared for by husband	Adjuvant chemotherapy	100%
16	42	Female	Completed	Full-time job	Married	>10,000 RMB	Cared for by	Adjuvant chemotherapy	50%

			ter-tiary school				par-ents		
18	50	Fe-male	Com-pleted sec-ond-ary school	Full-time job	Mar-ried	6000–10,000 RMB	Cared for by hus-band	Adjuvant chemo-therapy	100%
25	54	Fe-male	Com-pleted sec-ond-ary school	House-wife	Mar-ried	<3000 RMB	Cared for by hus-band	Adjuvant chemo-therapy	100%
26	37	Fe-male	Com-pleted ter-tiary school	Full-time job	Mar-ried	>10,000 RMB	Cared for by par-ents	Adjuvant chemo-therapy	83.3%
30	35	Fe-male	Com-pleted	Full-time job	Mar-ried	>10,000 RMB	Cared for by	Adjuvant chemo-therapy	16.7%

			ter-tiary school				par-ents		
31	39	Fe-male	Com-pleted ter-tiary school	Full-time job	Mar-ried	>10,000 RMB	Cared for by hus-band	Adjuvant chemo-therapy	100%

Table 2. Demographic characteristics of the nurse-interviewees (N = 5).

ID	**Age**	**Sex**	**Education**	**Post**	**Years of employment**
1	38	Female	University	Senior nurse	≧15 years
2	38	Female	University	Nurse-in-charge	10～15 years
3	31	Female	University	Senior nurse	5–10 years
4	27	Female	University	Nurse-in-charge	5–10 years
5	42	Female	College	Nurse-in-charge	≧15 years

Theme 1: patients' perceptions

A number of dominant themes and associated sub-themes were identified from the interview transcripts (Table 3, Table 4).

Table 3. Participants' perceptions of the dominant themes and sub-themes.

Interview structure	**Themes and sub-themes**

• Feasibility	Theme 1 Overall attitudes towards engagement in the program
	◎ Theme 1.1 Positive attitudes towards engagement in the program
	◎Theme 1.2 Negative attitudes towards engagement in the program
	Theme 2 Experiences with the visits and questionnaires
	◎Theme 2.1 Experiences with the pre-chemotherapy visit
	◎Theme 2.2 Experiences with the follow-ups
	◎Theme 2.3 Experiences with the study questionnaires
• Conceptual framework	
Influencing factors	Theme 3 Participants' perceived burden during the pilot study
	Theme 4 Participants' adherence to using the app
	◎Theme 4.1 Barriers
	◎Theme 4.2 Facilitators
Knowledge and beliefs	Theme 5 Changes in the participants after engagement in the program
	Theme 6 Experiences with using the app modules and functions
	◎Theme 6.1 Experiences with using the Knowledge base

Self-regulation skills and abilities	◎Theme 6.2 Experiences with using the Self-monitoring
	◎Theme 6.3 Experiences with using the Consultation
Social facilitation	◎Theme 6.4 Experiences with using the Alerts
	◎Theme 6.5 Experiences with using the Reminders
	◎Theme 6.6 Experiences with using My prescriptions
	Theme 7 Participants' perceived support

Table 4. Nurses' perceptions of the dominant themes and sub-themes.

Interview structure	**Themes and sub-themes**
• Feasibility	Theme 1 Overall attitudes towards engagement in the program
	◎Theme 1.1 Positive attitudes towards engagement in the program
	◎Theme 1.2 Negative attitudes towards engagement in the program
	Theme 2 Experiences with the recruitment and three visits
	◎Theme 2.1 Experiences with the recruitment
	◎Theme 2.2 Experiences with the pre-chemotherapy visit
	◎Theme 2.3 Experiences with the follow-up visits

• Conceptual framework	
Influencing factors	Theme 3 Patients' adherence to using the app
	◎Theme 3.1 Barriers
	◎Theme 3.2 Facilitators
Knowledge and beliefs	Theme 4 Changes in the nurses that occurred after their engagement in the program
	Theme 5 Experiences of using the app modules and functions ◎Theme 5.1 Experiences of using the Knowledge base
Self-regulation skills and abilities	◎Theme 5.2 Experiences of using the Self-monitoring
	◎Theme 5.3 Experiences of using the Consultations
Social facilitation	◎Theme 5.4 Experiences of using the Alerts
	◎Theme 5.5 Experiences of using the Reminders
	◎Theme 5.6 Experiences of using My prescriptions
	Theme 6 Nurses provided support

Overall attitudes towards engagement in the program

Regarding the overall evaluation of the app, many positive terms were identified, namely, "*usefulness, efficiency, a sense of security, a feeling of comfort, increased health awareness, and reduced number of visits to clinics*".

Participants' adherence to using the app

Barriers

Patients identified a total of eight barriers to explain why they did not comply with the app, namely, forgetfulness, too many reminders, negative physical and psychosocial conditions, a lack of feedback, problems in logging in, nothing to report, old age, and the lack of a contractual spirit.

(Patient, ID 12): "There were too many reminder messages. I ignored these messages and did not conduct the self-monitoring on time." "After one week, I had to log in to the system again. That week, I had just started to experience hair loss. Thus, I didn't log in again because I was not in a good mood."

Facilitators

A total of seven facilitators were identified to explain the participants' adherence to using the app, namely, perceived usefulness, professional support, sufficient time to report, ease of obtaining the information, increased health awareness, younger age, and contractual spirit. Specifically, one patient who works as a customer service staff member in an IT company commented that she adhered to using the app because she had signed the consent forms.

(Patient, ID 14): "I had enough time to complete the weekly self-monitoring." "I think it was meaningful. It reminds me that I should pay attention to my own health and psychological condition."

Participants' personal changes after engagement in the program

The participants perceived several positive and negative changes after participating in this program. The positive changes included *"being active in confronting cancer," "an increase in health awareness,"* and *"paying more attention to psychological symptoms."* The negative changes included *"being worried about the reported symptoms."*

(Patient, ID 10): "This app established a link that we can use to contact the hospital within 24 hours. Previously, the doctors were very busy and we were seldom able to see them. We also did not know what to do for the side effects. We could only search on the web. The more we searched, the more unsafe we felt. Now when I want to see a doctor or if I have any problems, I can contact the doctors and nurses in real time."

Participants' perceived support

Three kinds of support were identified from the group interview, namely, professional support, family support, and peer support. Some participants said that they received 24-h nurse-led support.

(Patient, ID 10): "I vomited a dozen times in one night. I used this app to report the vomiting problem. The nurse immediately sent me a referral to the emergency department.

Patient (ID 14): "In the whole process of chemotherapy, the nurses who cared for us gave the greatest support to me." "I could contact a nurse in real-time."

Nurses' perceptions

Overall attitudes towards engagement in the program

Most nurses exhibited a positive attitude towards the use of the app. Regarding the usability of the app, several positive terms were identified, including convenient, user-friendly, easy to use, and willingness to use. One nurse was amazed that the app had the artificial intelligence functions to deliver automatic nursing prescriptions. Another nurse suggested that the use of the app would be beneficial for future nursing research.

(Nurse, ID 2): "When patients reported symptoms, the system would send an alert to us. Some nursing prescriptions would be sent automatically to him/her. It had the functions of artificial intelligence."

Patients' adherence to using the app

Barriers

The nurses brought up the same five barriers as those mentioned by the patients to explain the patients' non-adherence to using the app, namely, forgetfulness, symptom distress, system problems, nothing to report, and old age.

(Nurse, ID 2): "For some elderly patients, if you ask them to complete a very long questionnaire, their compliance will be low."

In addition, nurses brought up one more barrier – i.e., the use of other ways of contacting nurses – to explain the patients' non-adherence to using the app. For instance, one nurse *(ID 1)* emphasized that *"a few patients chose to use their usual ways to contact nurses when they experienced severe vomiting, such as calling a hotline, instead of using the app."*

Facilitators

Besides perceived usefulness identified by patients, nurses suggested one more facilitator – "native high-adherence." Nurses commented that those patients who are "native high-adherence" usually comply with the protocol of weekly self-monitoring.

(Nurse, ID 1): "There were several patients who had been very active in participating in the research program. These patients, who are born with very high adherence, will adhere to the intervention protocol all the time, no matter which kind of questionnaire or which intervention they receive."

Changes in the nurses that occurred after their engagement in the program

All of the nurses emphasized that some positive changes had occurred over the six weeks of the program. For example, they stated that they were more engaged in symptom management via the app. One nurse (ID 3) said that *they became more focused on psychological symptoms such as insomnia during the six-week intervention program*. They found that the number of calls that the patients in the intervention group made to the hotline had fallen since their symptoms were handled using the app. Nurses did not need to respond to as many hotline calls as before; consequently, their workloads had become lighter during the six weeks.

(Nurse, ID 1): "It is a little different from our traditional routine work. In the past, we dealt with patients' symptoms only if we received a telephone call from the patients, and we would not actively track any further problems. After participating in this program, I became more active in interacting with patients, especially when I received a severe symptom report."

Nurses provided support

Nurses who engaged in this six-week program thought that it gave them valuable experience in providing improved professional support to patients through the app. Some nurses said that they could deliver tailored support by using the app for mild, moderate, and severe symptoms for patients with BC who were undergoing chemotherapy.

(Nurse, ID 3): "We could help patients solve some symptoms from a professional perspective."

(Nurse, ID 1): "If the patients reported their symptoms, the nursing prescriptions could be used to address these problems. Personal consultations could be used by patients, and we would send the tailored nursing prescriptions to an individual patient immediately."

Discussion

The majority of patients with BC appreciated the program, saying that the app was useful in helping them to self-manage their symptoms. Some of the participants, however, did not find the app to be helpful, and stopped using it during the six-week program. This finding is consistent with prior evidence indicating that users' attitudes could predict their adherence to app usage (Azhar and Dhillon, 2016; Donkin et al., 2011; Lewis et al., 2008).

A total of nine barriers to app usage, including the lack of a contractual spirit, were identified by the patients and nurses. A contractual spirit was seldom mentioned in prior mHealth studies. It refers to people who will follow a contract strictly after they sign it. A participant in our study complied with the weekly self-monitoring because she thought that she had promised to join the program and had to stick with it until the end. While some claim that there is a lack of a contractual spirit in Chinese society (Lv F, 2019), Chinese people spontaneously followed the contractual spirit of observing social restrictions during the COVID-19 pandemic, such as

maintaining social distancing and undergoing mass screenings (Annweiler et al., 2021). This indicates that if patients understand that the contract is closely related to their own health, they will spontaneously comply with the spirit of the contract, contributing to an improvement in adherence to mHealth app-based interventions. On the other hand, patients had been informed in the consent form that they were free to withdraw at any time during the intervention process, without reason or penalty. In this case, it appears that those participants who dropped out of the study or who did not follow the intervention cannot be said to be lacking in contractual spirit. The signing of the informed consent form did not impose an obligation on the participants. Patients who have the internal motivation (i.e., self-efficacy) to engage in self-management are more likely to persist in using the app, and thereby increase their rate of adherence to the mHealth app-based intervention.

None of the patients mentioned that the program had added an extra burden on them. Some nurses commented that they had felt some stress in connecting with patients by using the app, compared with their prior workload in providing routine care via a face-to-face mode. The nurses' perceived stress might have led to their low adherence to the intervention protocols. One possible reason for this is that the nurses had no incentive to use the mHealth intervention. To date, there have been no payments for mHealth app-based healthcare services in China. As stated before, in restricting the contractual spirit, no obligations should be placed on patients, and the same should apply to nurses. A future full-scale study should pay more attention to reducing the burden of mHealth app-based intervention on nurses and to improving the motivation of nurses to engage in mHealth app-based studies (Toode et al., 2011).

All of the nurses in the interviews emphasized that some positive changes had occurred over the six weeks, including the change from "providing reactive consultations to patients via hotline calls in the past" to "being actively involved in using the app for symptom management." Nurses found a considerable decrease in the number of unplanned hotline calls during the six weeks, as the barriers to implementation were resolved proactively by using the app (Wong et al., 2021). This suggests that self-management interventions not only lead to changes in the patients, but also facilitate changes in the nurses from being reactive by simply taking hotline calls to taking proactive measures depending on the integration of the self-regulation process and social support. For instance, some nurses said that they had begun to pay more attention to psychological symptoms such as insomnia after the completion of the six-week intervention.

With regard to the social support from nurses, it should be noted that some patients emphasized that they had received a very valuable healthcare resource because the nurses are from a prestigious hospital. In this study, a few patients who lived in rural areas received outpatient chemotherapy in Shanghai. They usually returned home between chemotherapy sessions. In rural areas, healthcare resources are not as accessible as in Shanghai. Since this program provided them with a channel to receive a remote healthcare resource from a Shanghai hospital, most patients were willing to participate in this program and follow the intervention, despite not receiving any incentives to engage in the study.

Strengths and limitations

This qualitative study was conducted following the practical guidance to qualitative research stringently. Two strategies were utilized for assessment of data saturation, namely, code frequency counts and Stopping Criterion (Hennink and Kaiser, 2022). Another strength of this

qualitative study is that it included two stakeholders (i.e., patients and nurses), which enriched the findings of the study. In addition, the structure of the group interview questions was guided by the IFSMT conceptual framework, which enabled the content of the interview to be more focused, and made it possible to tap deeply into the information. Meanwhile, because of the COVID-19 pandemic, one limitation was that the group interviews had to be performed via online meetings. The quality of online meetings could have been affected by the connectivity of the Internet. This suggests that future studies should be implemented via face-to-face meetings to obtain more meaningful findings in the post-pandemic era.

Conclusions

The patients' positive attitude toward their experience of using the app to deal with chemotherapy-related symptoms was identified as an important motivational factor in their sustained engagement in this mHealth study. Old age was an important barrier to adherence to app usage, while social support and native high-adherence were viewed as the key facilitators to the patients' rate of adherence to app usage. Patients experienced several changes after the six-week program, which included an improvement in their health awareness and a tendency to pay more attention to psychological symptoms. Meanwhile, the nurses had changed their approach from reactive to proactive after the six-week intervention. The findings from the group interviews indicated that the interaction between the technology and healthcare professionals facilitates self-management by patients.

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CRediT authorship contribution statement

Nuo Shi: Writing – original draft, Software, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. Nan Zhang: Software, Project administration, Methodology, Investigation. Frances K.Y. Wong: Writing – review & editing, Supervision, Project administration, Methodology, Conceptualization. Weiyi Zhu: Project administration. Xiaobin Lai: Software, Formal analysis, Data curation. Chengjia Gu: Investigation. Xiaojing Dong: Investigation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Open-ended questions designed into a semi-structured group interview guide

Items	Questions	Feasibility	Conceptual framework			
			Influencing factors	Knowledge and belief	Self-regulation skills and abilities 1 Goal setting 2 Self-monitroing 3 Decision-making 4 Planning 5 Action 6 Reflective thinking 7 Self-evaluation	Social facilitation
Q1	What was your overall experience of participating in the pilot RCT?	√				
Q2	How would you evaluate the pre-chemotherapy consultation and two follow-up visits?	√		√	1. √ 4. √	√
Q3	How would you evaluate the instruments/questionnaires that you completed during the study period? Including: -the SUPPH you were required to complete in the pre-chemotherapy consultation and at the end of the intervention to assess self-efficacy; -the FACT-B, which you were asked to complete in the pre-chemotherapy consultation and	√			7. √	

	at the end of the intervention to evaluate health-related QoL status; -the MSAS-SF-SC, which you were required to complete at the end of the intervention to measure symptom distress and frequency; -the adherence to self-management protocols, which you were required to complete at the end of the intervention to evaluate adherence to self-management protocols of 8 chemotherapy-induced symptoms; and -the intervention satisfaction, which you were required to complete at the end of the intervention to rate the healthcare service you received during the study.					
Q4	How would you evaluate the mChemotherapy in terms of the dosages (i.e., content, frequency, and duration)? -Self-monitoring? -Alerts? -Reminders? -Consultations?	√			2. √ 3. √ 5. √ 6. √	√

	-My prescriptions? -Knowledge base?					
Q5	Besides the issues mentioned above in Q4, are there any other reasons that made it easy/difficult to continue with self-monitoring?		√	√		√
Q6	What changes did you experience during the study?			√		
Q7	What kind of burden did you encounter during the study?	√	√	√		
Q8	Would you consider using mChemotherapy to support self-management of other health problems? Why?	√				
Q9	What are your recommendations/suggestions to help us improve the study design (and mChemotherapy in the future)?	√				