The Peer Support for Elderly Breast Cancer Patients' Continuing Care at Home Through Smart Service System

Bo Gao[1,2](✉) and Siying Chen[2]

[1] The Joint NTU-UBC Research Centre of Excellence in Active Living for the Elderly (LILY), Nanyang Technological University, Singapore, Singapore
`bo.gao@ntu.edu.sg`
[2] Tongji University, Shanghai, China

Abstract. Breast cancer is the first most frequent cancer and cancer with the highest incidence and the most frequent cancer among women globally. Elderly female patients with breast cancer need peer support to maintain their physiological and psychological health. Strengthening peer support in the continuing care at home requires maintaining the continuation of information between home and hospital, strengthening the relationship between the stakeholders, helping elderly patients recover physically and mentally through enhancing the user experience. We present the progress and results from the research adopted a series of UCD (user-center design) methods since 2018. We did the co-creation workshops with four breast cancer hospitals, 68 breast cancer patients, and eight families to clarify the needs and capture the experience of the patients and family caregivers. We designed the "Bcare," the smart service system for peer support in daily routine care at home based on these research. Through the testing, "Bcare" has been proved to improve the satisfaction of patients and family caregivers' experience and reduce the burden of care for family caregivers.

Keywords: Breast cancer · Continuing care · Peer support · UCD (user-center design) · User experience

1 Introduction

The number of breast cancer patients had reached 2.26 million, becoming the "world's largest cancer" [1]. It is a cancer with the highest incidence and the most frequent cancer among women in the world, with an incidence of 24.2% [2]. After breast cancer surgery, patients need to receive regular long-term physical examinations, once every 3 months within 2 years, every six months for 3–5 years, and once a year after 5 years [3]. The risk of recurrence is two peak periods in the second and fifth years after surgery, and the peak of the former is higher than the latter [4]. The long-term and periodic breast cancer treatment will experience life-long treatment. Many patients began to take it lightly after the 5-year peak of recurrence, which lead to recurrence [6]. Continuing care

H. Lewy and R. Barkan (Eds.): PH 2021, LNICST 431, pp. 302–317, 2022.
https://doi.org/10.1007/978-3-030-99194-4_19

after breast cancer surgery is closely related to the recurrence rate. Elder patients need to switch between the different scenarios, such as hospital, community, and family after breast cancer surgery. Continuing care is to ensure that when patients transfer between different scenarios, the health services they receive are coordinated and continuous, and prevent or reduce the deterioration of the patient's health [5].

The existing medical system in Shanghai mainly deals with acute and sudden medical services, lacks sufficient medical resources to take care of patients after surgery. Breast cancer as the cancer with the reproductive organs, the treatment is affected by social ethics, social relations and self-awareness during rehabilitation [3]. After tracked the data of the breast cancer patients after their recovery for three years in Yangpu Central Hospital Shanghai, China. We found that the hospitals only remind patients of regular physical examinations and medication guidance, but psychological communication needs to be strengthened, especially for targeted counseling based on elderly patients' psychological characteristics. Elderly breast cancer patients often have strong negative psychology and a sense of uncertainty about the disease. The depression rate of elderly patients accounts for 32.76%, which is much higher than that of younger patients [8]. At the same time, elder patients experience a reduction of their social support structure due to life events, such as widowhood and retirement. This may lead to isolation and loneliness, which may exacerbate their emotional response to cancer [9]. Elderly patients have a strong sense of psychological anxiety and need to obtain close and lasting interpersonal relationships [18].

Peer support, which is underpinned by components of social cognitive theory [19] and the theory of planned behavior [20], uses trained individuals who have shared experiences and who provide knowledge, emotional, social and/or practical help to support others. Peer support is mostly used for the management of chronic diseases. In recent years, peer support has been effectively applied to breast cancer continuing care with the trend of "treat cancer as a chronic disease". Peer support creates the necessary emotional communication scenarios to control disease and maintain health, provide social and rehabilitation assistance, and supple other health-care services [10]. Peer support therapy combined with social support can reduce patients' loneliness, assists in the implementation of medical care programs more fully, and improves the quality of patient self-management [12].

The previous research on peer support in China used in the hospital, mainly in offline face-to-face communication with the breast cancer patients, medical staff and volunteers [11]. The face-to-face offline peer support has difficulty continuing for elderly patients or during the isolation in Covid-19 [26]. And previous research on peer support online is mostly conducted in hospitals [13, 14], lacks the research on homecare.

The purpose of this research and the design of "Bcare" are to enhance the peer support for elder breast cancer patients in continuing care service at home. Breast cancer continuing care at home in Shanghai needs to focus on three continuations [7]:

1) The continuation of information refers to patients to ensuring the accuracy of patient information during the referral process in different medical scenarios.
2) The continuation of medical services refers to patients to ensure patients always receive continuous health care throughout the health service system.

3) The continuation of relationship between doctors and nurses, patients and families refer to patients receive services from different health caregivers while maintaining a good relationship between stakeholders.

This paper is divided into the following parts: Sect. 1 introduces some background of peer support in continuing care of breast cancer; Sect. 2 analyzes related works. Section 3 presents the design process of the smart service system, named "Bcare"; Sect. 4 introduces the development and the results of the testing of the design prototype. Section 5 introduces the conclusion and future work.

This paper highlights two key contributions to the field of HCI and UCD for homecare:1) combined the method of UCD (user-center design) to gain insight into the physical and psychological needs of elder breast cancer patients and their families in homecare, and transfer the insight into the practice design 2) Focus on the special patient groups of elderly breast cancer patients, and explore the use of ICT technology to establish a hospital-community-family peer-supported service system in the informal family care that may inform similar or future research.

2 Related Works

There are four core functions of peer-support in continuing care of breast cancer in the previous research [11]:

1) assist in daily management.
2) provide social and emotional support.
3) establish connections with hospital care and community resources.
4) provide active, flexible, and continuous long-term follow-up service.

At present, in Europe and the United States, peer support combined with the local primary medical systems. Most of the companion support therapy in China used in the hospital, mainly in offline communication with the breast cancer patients, medical staff, and volunteers.

2.1 Peer Support in Offline Communities

Peer support programs which consist of cancer survivors as mentors furnish cancer patients with unique emotional and educational benefits [21, 27]. The research from Japan examining the sources of supportive care in breast cancer illustrated a high need for peer support in addressing medical-psychological, social-spiritual, and sexual needs [22]. The Corsi di Cucina cooking class on healthy diets for cancer patients' families in in Milan. Peer support is mainly the teaching and answering of experts and the sharing and communication between patients and family caregivers. The highlight of peer support is the table sharing the link of cooking teaching results sharing. All stakeholders can easily find topics from the cooking teaching content and the patient's recovery experience and effectively communicate with high emotional concentration.

2.2 Peer Support in Online Communities

The research from Japan explored the differences in peer support received by lurkers and posters in online breast cancer communities. The posters felt they received more benefits from online communities than lurkers did, including emotional support, helping other patients, and expressing their emotions. And the lurkers were found to gain a certain amount of peer support through online communities, especially about advice and insight/universality [13]. In 2017, a study on the discovery of peer support to improve the benefits of breast cancer patients at the Chinese Academy of Medical Sciences and Peking Union Medical College Hospital. It has been proved that most of the positive psychological indicators of the experimental group patients have improved [14].

2.3 Peer Support in Online + offline Communities

The characteristics of China's urban and rural development and the one-child policy have affected the composition of families and communities, making the offline implementation of peer support face greater resistance. At the same time, China's smart medical development and internet penetration quickly, the peer support via online and offline communities can break geographical boundaries, communicate more efficiently and instantly, connect various scenario of patients' lives to ensure the continuity and effectiveness of health services. The Shanghai Cancer Center built the "Yankang e-follow-up" online community in wechat platform, patients and their families can complete preliminary screening, diagnosis, and establish communication with experts through this platform, which is convenient for postoperative chemotherapy, endocrine therapy, medication dispensing, follow-up, etc. [15]. The online community also provides a channel for patients to talk to each other, which relieves patients' psychological anxiety and pressure. Yankang e-follow-up also organizes various offline communities' activities to provide patients with psychological counseling or professional lectures, play a role in alleviating psychological anxiety.

2.4 UCD (User-Center Design) Adopted in Breast Cancer Continuing Care

More medical research results on patients' diseases and treatment experience show that medical services provided from this biomedical perspective alone cannot produce satisfactory results, and interventions from a perspective beyond treatment are required [25]. Users have begun to participate in the process of design and innovation as an indispensable factor, their involvement lead to more effective, efficient and safer products and contributed to the acceptance and success of products [14, 24]. User-centered design (UCD) is a general term for a philosophy and methods which focus on designing for and involving users in the design of computerized systems [23]. The user-centered rule in the medical-related design process has gradually shifted to center on the user experience. UCD (user-center design) has been used in health care, the methods of UCD such as "empathy design", "service design", and "collaborative design", "design thinking" have been developed to integrate the patient's status, experience, and psychological feelings, etc. into the scope of design considerations [15, 16, 28].

The existing projects have helped to establish “peer support” in continuing care, such as the “HOPE” series of continuing care services by the National Breast Cancer Foundation USA. The “HOPE” service helping more stakeholders to support patients build confidence in defeating cancer. The Moira course for breast cancer in Italy follows the EBCD (Experience-based co-design) principles and provides breast cancer patients with opportunities for peer communication to promote the patients’ full physical and mental recovery. The “Staying the Course” project designed by the Royal College of Art in 2017, produced a smartphone application to help patients conduct cognitive education, build a bridge between patients and caregivers, and provide relevant information about their specific treatment. In 2018, Northeast Illinois University launched “My Guide”, a community-supported method of building applications to help patients with community-based peer support. The Breast Cancer Integrated Care Collaborative (ICC) at North York General Hospital (NYGH) have more than 40 experts, including patients and families, through extensive consultation co-designed the new care model. Using an innovative approach to link medical and support services together, with evidenced-based practice as a lever for change, the ICC was developed to provide a seamless, integrated patient- and family-centred care approach from diagnosis to survivorship.

3 Methods

3.1 UCD (User-Center Design) Adopted in Breast Cancer Continuing Care

Since 2018, we did the multi-discipline research by using UCD (user-center design) in three phases, worked with four breast cancer hospitals, 68 breast cancer patients (the age from 65–80, $\geq$1-month post-treatment), eight families, 18 family caregivers (the age of from 22–46, 9 female and 9 male). The age ranged from 22 to 80 years. Then, we summarized the direction of design from the perspective of patients and family caregivers.

In the investigation phase, we investigated and observed the situation of peer support in the continuing care by the patients, family caregivers, medical staff, and online and offline community organization workers. Then, we conducted structured interviews and semi-structured interviews with selected users, recorded and analyzed the different psychological feelings of patients during the transition of different continuous service scenarios, then gained insights and sum up the needs of patients.

In the design phase: the research team held two co-creation workshops using tool A, B, C, D to develop the patient’s journey map of continuing care, patients’ information chart and peer support experience chart, and service scenario.

In the evaluation phase, the patients, family caregivers and doctors evaluated the “Bcare” service system prototype.

3.2 UCD (User-Center Design) Tools

We organized two co-creation workshops in discussed the five questions raised by investigation research:

1) The basic information of the patients and the status of peer support in the breast cancer continuing care.
2) The method of the patients do the self-management after the surgery and the role of the family caregiver in this process.
3) The medium for patients to use for recording data in continuing care.
4) The method for family caregivers to obtain patients' information in daily routine care.
5) The patient's experience of participating in the online and offline peer support community in homecare.

There are three participants in the first co-creation workshop, including two patients recovering at home after the operation, one is 54 years old and the other is 72 years old. The 72 years patient's daughter also participated in the workshop as a family caregiver. The workshop lasted two hours. We used tool A, B, C to collect reviews of the pains in body and the comments of the service and activities in the treatment, developed the patient's postoperative treatment journey map, patients' information chart and patient's experience. Based on the first cocreation workshop, we designed tool D and used it in the second co-creation workshop to develop the service scenario. There are nineteen participants, including eight patients recovering at home after the operation (the age from 65–80, ≥1-month post-treatment), and 4 fully-registered, practicing medical staffs (2 doctors and 2 nurses), seven patient's families also participated in the workshop as a family caregiver (the age from 22–46, 4 female and 3 male). Informed consent was obtained from each participant before the workshop. Shopping vouchers worth 100 RMB were received by each participant after the experiment as compensation. Then, we summarized the direction of design from the perspective of patients and family caregivers.

Tool A: To Develop the Patients' Information Chart

Tool A including the panda dolls and rehabilitation record is used to develop patients' information chart. We use panda dolls wearing postoperative lymphatic massage patterns to guide patients and family members to recall their memory of the mental journey after surgery. It worked well as an ice-breaking tool in opening the topic and enlivening the atmosphere. The rehabilitation record lists the questions including patients' habit of making recovery records, the way of patients to record rehabilitation data. From outcome of the patients' information chart, we find that the most important information points need to be recorded are medication, exercise, diet, doctor's advice, recovery time management, and family caregivers should provide supervision and rewards during the continuing care period. The information channels are mainly paper-based newspapers and wechat in mobile phone, a small amount of TV and related reports on health websites (Fig. 1).

Tool B: To Develop the Patient's Continuing Care Journey Map

We used Tool B to develop the patient's continuing care journey map. At first, we used Tool B to guide the participants to share their experience of peer support in continuing care and fill the information into the map. The horizontal headings of Tool A are five

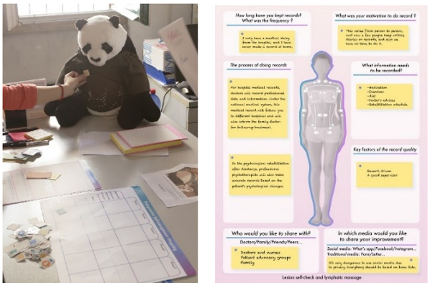
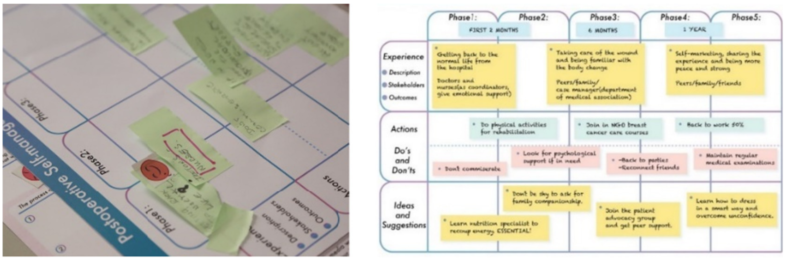


Fig. 1. Tool A including the panda dolls and rehabilitation record to develop the patients' information chart.

phases of the continuous care to be defined by the patient from left to right, and the vertical headings from top to bottom are the specific experiences of peer support, including the patient's actions, ideas, and suggestions. We learned from the conversations between patients and family caregivers that family caregiver learned that the mother was in a state of depression and extreme lack of self-confidence for a long time after surgery. From the patient's continuing care journey map, we found that the patient needs are the assistance of rehabilitation exercise and the sense of companionship throughout the whole continuing care process. The patient's adherence to postoperative self-management stems from the internal drive to reintegrate into the social circle, family caregivers should act in it as the role of encourager and supervisor in homecare (Fig. 2).



	Phase1:	Phase2:	Phase3:	Phase4:	Phase5:
	FIRST 2 MONTHS		6 MONTHS	1 YEAR	
Experience ● Description ● Stakeholders ● Outcomes	Getting back to the normal life from the hospital Doctors and nurses(as coordinators, give emotional support)		Taking care of the wound and being familiar with the body change Peers/family/ case manager(department of medical association)		Self-marketing, sharing the experience and being more peace and strong Peers/family/friends
Actions		Do physical activities for rehabilitation	Join in NGO breast cancer care courses		Back to work 50%
Do's and Don'ts	Don't commiserate	Look for psychological support if in need		-Back to parties -Reconnect friends	Maintain regular medical examinations
Ideas and Suggestions	Learn nutrition specialist to recoup energy. ESSENTIAL!	Don't be shy to ask for family companionship.	Join the patient advocacy group and get peer support.		Learn how to dress in a smart way and overcome unconfidence.

Fig. 2. Tool B is to develop patient's continuing care journey map.

Tool C: To Develop the Peer Support Experience Chart

Tool C is designed to understand the patient's experience of participating in peer support online and offline communities' activities, the relevance of activity types and personal hobbies, and the help that family caregivers can provide during the activities. We selected 12 kinds of activities usually acted in the continuing care, including dance, yoga, online course, sing, massage, art creating, online game, jogging, gardening, storytelling, recipe sharing and book club. We drew these 12 kinds of activities cards for patients to choose 4 of them and set a blank area next to the selection area for patients to fill in freely. Participants can share experiences and thoughts while doing physical exercises (Fig. 3).

Peer Support and Co-management

If you do co-exercise with your family caregiver, what kind of exercise you prefer?

Draw here if you have another idea

What do you think if peers could do co-management about your exercises in online platform (schedule making/data sharing/community building...)?

Advantages+	Disadvantages-
	Exclusion from the community, face to face communication is better

What is the motivation of self-management do you think the peer support may give?

- -Experience sharing
  -Mutual supporting
  -Continuous concern

Do you think a physical tool is needed for helping self-management at home?

- Manual of therapy
  -Reflexology foot
  -Lymphatic massage

Fig. 3. Tool C is to develop peer support experience chart.

Tool D: To Develop the Service Scenarios

Based on the outcome of the first co-creation workshop, we put forward the design hypotheses and designed tool D and used it in the second co-creation workshop. Tool D includes seven visualized service scenarios, including: access to services, daily records, one meeting a week, good moments, social activities, monthly summaries, and harvest memories. Then we showed the seven service scenario with the explanation of the service story to six patients, four fully-registered, practicing medical staffs (2 doctors and 2 nurses) and seven patient's families. Then, the participations expressed their opinions and used the different colored notes we provided to fill in their opinions. The green notes are from middle-aged postoperative patients, the red notes are from elderly postoperative patients, the orange notes are from family caregivers, and the purple notes are from medical staffs. Based on the perspectives of different stakeholders, we have a deeper understanding of the key points of the adaptability of the adjustment plan, and after adjustments we developed the new service scenario (Fig. 4).

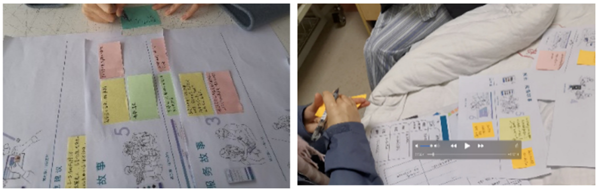


Fig. 4. Tool D is to develop the service scenarios.

3.3 The Direction of the Design

Based on the results of the co-creation workshop, we put forward a framework of the peer support of homecare in continuing care, and use this framework to guide the direction of design. The framework is divided into three steps, peer support norms, peer support cooperation and peer support target. Three steps promote each other, and will continue to update with the social environment changes and technological applications, forming one recycled service. We believe that the concept of "patient-centered" needs to be transformed into "family center", it is important to treat patients and their families as a whole and focus on the cooperation relationship in the family care. The experience of family caregiver will affect the patient's experience and physical and mental recovery. The "family center" is the center of this service system.

Peer support norms is the first step. Patients, family caregivers, and medical staff are aware of the importance of incentive, communication, and accessibility tools, and agree that they are the prerequisites for promoting innovation in peer support services. Peer support cooperation is the second step. Optimizing the interactive experience of patients to families, doctors to patients, and patients to platforms in the service system can promote the completion of the third step. The third step is the peer support target. The peer support target not only requires individual improvement, optimal usage, but also treat the physical and mental health, the individuals and groups patients' health as the holistic health (Fig. 5).

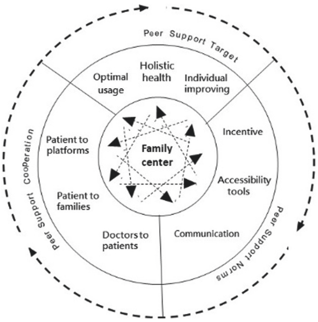


Fig. 5. The framework of the peer support of homecare in continuing care

We summarized the design direction from the framework. There are three design direction, including the psychological rehabilitation support, physical rehabilitation support, and the form of the information communication platform.

1) The design focus on the psychological rehabilitation support is to allow patients to experience the sense of companionship brought by family caregivers and to encourage patients to get rehabilitation achievements in different phase.
2) The design focus on the physical rehabilitation support is for family caregivers to supervise the patients' medication, diet, etc. Implementation of exercises, physical examinations, etc., and participation in offline peer support activities with patients.
3) The design focus on the information communication platform that assist patients in completing rehabilitation data records efficiently and help family caregivers and medical teams can track the data and give feedback in time.

4 "Bcare" Design

The research team designed the "Bcare", a smart service system of peer supported for elderly breast cancer patients' continuing care, is mainly composed of four parts, the Bcare service platform for patients, the Bcare App for family caregivers, "Bcare WeChat Mini Program" for patients and "Bcare" hospital continuing service management linking with the hospital.

4.1 "Bcare" Service Platform for Patient

"Bcare" service platform for patients, help patients to continuously record rehabilitation data, and trigger discussion and information exchange between family caregivers and patients. Patients learn about the knowledge of post-operative rehabilitation both through the "Bcare" App for the family caregiver and paper based "Bcare" rehabilitation manuals, images and video guidelines for post-operative exercises, guidelines for healthy eating, etc.

The elderly patients who are inconvenient to use mobile phones and prefer to use traditional paper materials, can mark in the record page with three items (medication/diet/exercise) in the patient's paper rehabilitation manual, and write down the memo (physical examination schedule/doctor's advice). Paper-based "Bcare" rehabilitation manuals are suitable for elderly patients to identify and learn, and record quickly, the daily recording time is within 5 min.

When family caregivers communicate with patients every weekend, they can check paper based "Bcare" rehabilitation manuals and continuously upload the patient's data into the "Bcare" App for the family caregiver.

4.2 "Bcare" App for the Family Caregiver

The main functional interfaces of the "Bcare" App for family caregivers include the welcome page, registration page, home page, data entry page, activity page, appointment page, and communication page, etc. The four major functions of the navigation bar are "Homepage", "Supervision", "Moments ", and "Community". The "Homepage" section provides rehabilitation guidelines and peer support information to family caregivers; family caregivers can browse the patient's past rehabilitation records and the information of phased curve changes on the "Supervision" section; In "Moments" section, the family caregivers can upload the pictures of memorable moments in the patient's recovery process; "Community" section includes the connection of the online and offline peer support community activities. Family caregivers can share the latest information and discussing with the patients to make an appointment. In the "appointment" section, family caregivers can make appointments to hospitals, and online offline community activities. It also can make online modifications according to the needs of patients. Patients will be encouraged to develop personal hobbies and expand social interactions through these peer support activities. It is synchronized with the information on the "Bcare WeChat Mini Program" used by the patients, and family caregivers can send messages to remind the patient to have a face-to-face consultation on time.

Family caregivers can connect with the hospital's continuation service on the "communication" page, to keep in touch with the medical team from hospital, obtain timely recommendations, as well as the continuation service made by the hospital based on the patient's recovery. At the end of each month, the family caregivers will receive the patient's overall recovery data and targeted suggestions from the "Bcare" App system. The system will also encourage and reminders based on the input and data of patients and family caregivers. The system will also send reference questions for family caregivers to stimulate discussion and communication with patients (Fig. 6).

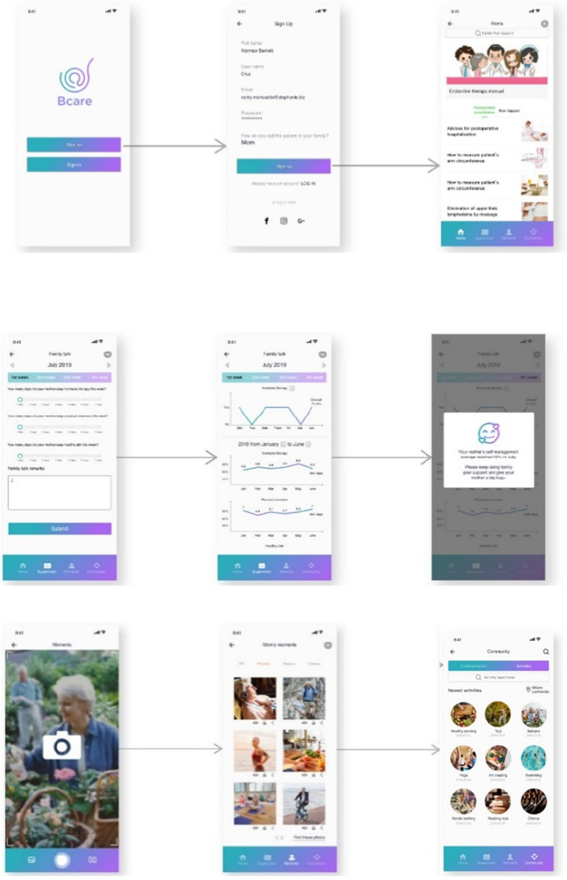


Fig. 6. The interface of "Bcare" App for the family caregiver.

4.3 "Bcare WeChat Mini Program" for Patients

According to the different digital literacy of patients, Bcare also set up in WeChat Mini Program, which is convenient for elderly patients who can use mobile phones. WeChat

Mini Programs are "sub-applications" within the WeChat ecosystem. They enable to provide advanced features to users such as e-commerce, task management, coupons, etc. in China [17]. Patients who can log in to the "Bcare" WeChat Mini Program on their own mobile phone, they can quickly check in the medication, diet, and exercise in the daily check-in section. Patients can write down their memos by converting voice to text. The patient also can share the check-in list results to the WeChat patient peer support group, and invite other patients to join the "Bcare" WeChat Mini Program.

The patient's "Bcare" WeChat Mini Program set up an associated account with the family cares' App terminal. The family caregiver can view and remind the patient's appointments, such as physical examination in real-time, and also can get the information about the patient's daily check-in status in the "supervision" function.

4.4 "Bcare" Hospital Continuing Service Management

"Bcare" hospital continuing service management is mainly a computer web page, consider that main usage scenarios and interaction habits of medical staff from the hospital. "Bcare" hospital's continuing service management port mainly has two sections: (1) Doctors can quickly manage related patients, review the patient's treatment status and recent physical reports, and deal with them promptly. At the same time, the service system will automatically match the relevant knowledge and send it to the patients and caregivers, according to the keywords of the doctor's order; (2) Doctors can communicate with patients and caregivers in time and can also communicate with another stakeholder (such as they can make connections between different hospitals, introduce the online and offline peer support community), to achieve the continuation of information, relationships, and care for patients.

5 Preliminary Results

In the user testing session, the research team invited 25 users, including ten elder patients (the age from 65–80, $\geq$1-month post-treatment), 10 family caregivers, and 5 fully-registered, practicing medical staffs (3 doctors and 2 nurses) to test the design prototypes and give the scoring. The specific process of the testing was: 1) We treated 10 elder patients and 10 family caregivers as the "Bcare" main users, they were asked to rate the satisfaction of the existing continuous care services by using Table 1, a seven-point Likert scale (1 = Strongly disagree, 2 = Disagree, 3 = Slightly disagree, 4 = Neutral, 5 = Slightly agree, 6 = Agree, 7 = Strongly agree) 2) through the introduction of the research team, users tried and experienced the "Bcare" step by step. The users communicated with the research team and gave comments and suggestions. 3) the users completed the Table 1 again after testing the prototype of "Bcare" to do the comparison.

The scoring focus on the evaluation of the user's experience about service scenario: 1) The experience in the switchover between medical institutions and continuing care service scenarios, such as home and offline community. 2) The experience in the participation of online and offline communities' activities. 3) The experience of communication and interaction within the family members.

The scoring items are the acquisition of rehabilitation and health care information, communication and interaction with peers, and peer support in physical rehabilitation and peer support in psychological rehabilitation. A total of 13 questions about physical examination, peer support activities and peer support at home to evaluate the user's experience. The instrument is shown in Table 1.

Table 1. The satisfaction score of user's experiences

Physical examination	Score						
1: Satisfied with the rehabilitation health information provided by physical examination in continuing care	1	2	3	4	5	6	7
2: Satisfied with the communication with the doctor or other stakeholders support physical examination in continuing care	1	2	3	4	5	6	7
3: Physical rehabilitation status in the medical examination is good	1	2	3	4	5	6	7
4: Emotional state is good in the physical examination of the continuing care	1	2	3	4	5	6	7
Peer support activities	Score						
5: Satisfied with the rehabilitation information obtained during the offline peer support community activity	1	2	3	4	5	6	7
6: Satisfied with the communication with the doctor or other stakeholders during the offline peer support community activity	1	2	3	4	5	6	7
7: physical rehabilitation status during attending the offline peer support community activity is good	1	2	3	4	5	6	7
8: Emotional state is good during attending the offline peer support community activity	1	2	3	4	5	6	7
Peer support at home	Score						
9: Satisfied with the information of continuing care at home	1	2	3	4	5	6	7
10: The support received from a doctor in continuing care at home	1	2	3	4	5	6	7
11: I had the support received from a family caregiver at home is good	1	2	3	4	5	6	7
12: Physical rehabilitation while receiving support from a family caregiver is good	1	2	3	4	5	6	7
13: Emotions while receiving support from a family caregiver in the continuing care at home is good	1	2	3	4	5	6	7

1: Strongly disagree; 2: Disagree; 3: Slightly disagree; 4: Neutral; 5: Slightly agree; 6: Agree; 7: Strongly agree.

The average score of the existing continuous care services by 10 elder patients is 2.9. The average score is 5.4 after they tested the prototype of "Bcare". The test results show that the satisfied rated by elder patients has improved by average score 2.5 points. Among them, the largest improvement was about the physical rehabilitation while receiving support from a family caregiver in the twelfth question, reaching 3.8 points. The improvement of physical examination is 2.625 points, the average score for the improvement of peer support activities is 2 points, and the total score for the improvement of peer support at home is 2.88 points.

The average score of the existing continuous care services by ten family caregivers is 2.8. The average score is 5.4 after they tested the prototype of "Bcare". The test results show that the satisfied rated by family caregivers has improved by average score 2.6 points. Among them, the largest improvement was about the satisfaction of the information about continuing nursing at home in the ninth question, reaching 3.2 points. The improvement of physical examination is 2.475 points, the average score for the improvement of peer support activities is 2.4 points, and the total score for the improvement of peer support at home is 2.9 points.

The scores had reflected that "Bcare" has indeed improved the satisfaction of users' experience. And it is prominently manifested in the scenarios of taking physical examinations after surgery and the communication and interaction scenarios within the family, especially the acquisition of rehabilitation and health care information in the scenarios and the communication and interaction with peers.

Five fully registered, practicing medical staffs (three doctors and two nurses) were involved in the feedback exercise. A nurse believes that the interactive form of the patient's check-in can be combined with the patient's social sharing habits, and a doctor suggested that the content of the communication with the doctor and patients can be incorporated into the electronic medical record as a reference.

Some experience design needs to be updated:

1) Patients and family caregivers thought doctor-patient communication is very important in the whole continuing care process. They hope to obtain online Q&A from medical staff in a timely and efficient manner, and patients can get promptly remind of appointment information, such as physical examinations.
2) Patients and stakeholders had a higher demand for a healthy diet and knowledge guidance on rehabilitation exercises for patients.
3) Patients believed that the companionship of relatives and friends is an important form of psychological rehabilitation support.
4) Patients believed that the participation of offline peer support community activities should be selectively based on the patient's interests and hobbies.
5) Patients are more inclined to use online platforms to complete daily records, and especially hope to build the platform on a communication platform that is frequently used daily, such as WeChat. At the same time, they worried about the privacy of personal information.
6) Patients believed that it is the patient's responsibility to complete the daily rehabilitation record and companionship by family caregivers is already the best form of family support.

6 Conclusion

Breast cancer rehabilitation after surgery is a long and tortuous process, elderly breast cancer patients and their family caregivers need the help to maintain comprehensive and effective chronic disease management of the patient's physiology, psychology, and quality of life in homecare. In this paper, we present the design process of "Bcare", we used the UCD (user-center design) to gain insight into the physical and psychological needs from elder patients and family caregivers and put forward a framework of the peer support of homecare in continuing care. We designed the "Bcare" to make the effective media channel for elder patients and family caregivers to get the rehabilitation and health care information and increase the communication and interaction between the family caregivers and hospital. To evaluate the developed design prototype, we have conducted 25 users including 10 elder patients, 10 family caregivers, and 5 fully registered, practicing medical staff to test the prototypes. The great majority of them gave overall good score on "Bcare", they also believe the developed system will be useful for elderly breast cancer patients in terms of getting peer support in continuing care at home.

When applicability of these results to other cultural populations, we need to notice that peer support has different manifestations in different social. The peer support activities need to focus on local patients' real needs, integrate into the local social resources, medical resources, and maximize peer support activities' benefits.

In future, we would like to 1) Based on user feedback, iterate plans to improve elder user experience and to protect users' privacy. 2) Strengthen the research of peer support in emotional to deal with the psychological problems that plague female patients in the continuing care. 3) Increasing technical to matches the hospital medical system, cooperate with more stakeholders, and considering the adaptability to be used in post-epidemic era.

Acknowledgments. Specials thanks to the all the participations in this research. This research is supported, in part, by the National Research Foundation, Prime Minister's Office, Singapore under its IDM Futures Funding Initiative; AISG-RP-2019-050.

References

1. The International Agency for Research on Cancer (IARC): Latest global cancer data: cancer burden rises to 19.3 million new cases and 10.0 million cancer deaths in 2020
2. Lancet, T.: GLOBOCAN 2018: Counting the toll of cancer. Lancet **392**(10152), 985 (2018)
3. Aizpurua-Perez, I., Perez-Tejada, J.: Resilience in women with breast cancer: a systematic review. Eur. J. Oncol. Nurs. **49**, 101854 (2020). https://doi.org/10.1016/j.ejon.2020.101854
4. Demicheli, R., Abbattista, A., Miceli, R., Valagussa, P., Bonadonna, G.: Time distribution of the recurrence risk for breast cancer patients undergoing mastectomy: further support about the concept of tumor dormancy. Breast Cancer Res. Treat. **41**(2), 177–185 (1996). https://doi.org/10.1007/BF01807163
5. Coleman, E.A.: Falling through the cracks: challenges and opportunities for improving transitional care for persons with continuous complex care needs. J. Am. Geriatr. Soc. **51**(4), 549–555 (2003)
6. Dowsett, M., et al.: Integration of clinical variables for the prediction of late distant recurrence in patients with estrogen receptor-positive breast cancer treated with 5 years of endocrine therapy: CTS5. J. Clin. Oncol. **36**(19), 1941–1948 (2018)
7. Haggerty, J.L., Reid, R.J., Freeman, G.K., et al.: Continuity of care a multidisciplinary review. BMJ **327**(7425), 1220–1223 (2003)

8. Diao, L.H., Niu, Y.H., Li, Y.L.: Nursing and investigation of correlation between depression and social support of elderly patients with cancer. Chin. J. Nurs. **37**(05), 16–18 (2002)
9. Hu, Y., Huang, Y.L.: To Be with You and Support with You. Shanghai Scientific and Technical Publishers (2008)
10. Solomon, P.: Peer support/peer provided services underlying processes, benefits, and critical ingredients. Psychiatr. Rehabil. J. **27**(4), 392–401 (2004)
11. Mead, S., Hilton, D., Curtis, L.: Peer support: a theoretical perspective. Psychiatr. Rehabil. J. **25**(2), 134–141 (2001)
12. Setoyama, Y., Yamazaki, Y., Namayama, K.: Benefits of peer support in online Japanese breast cancer communities: differences between lurkers and posters. J. Med. Internet Res. **13**(4), e122 (2011)
13. Zhao, H.Y., Zhang, Y.B., Ma, Y.F.: The experience of peer support to improve the discovery of benefits for patients after breast cancer surgery. J. Nurs. **24**(14), 76–78 (2017)
14. Dong, F.: Breast cancer patients: please leave it to WeChat to take care of it. Comfort Life (12), 10–11 (2015)
15. Mannonen, P., Kaipio, J., Nieminen, M.P.: Patient-centred design of healthcare services: meaningful events as basis for patient experiences of families. Stud. Health Technol. Inform. **234**, 206–210 (2017)
16. Yu, E., Sangiorgi, D.: Service design as an approach to new service development: reflections and futures studies. In: ServDes 2014. Fourth Service Design and Innovation Conference, Lancaster, United Kingdom (2014)
17. ECOVIS R&G Consulting Ltd. (Beijing) and Advantage Austria. E-commerce in China, Industry report (2015)
18. Kadambi, S., et al.: Social support for older adults with cancer: Young International Society of Geriatric Oncology review paper. J. Geriatr. Oncol. **11**(2), 217–224 (2020)
19. Ajzen, I.: The theory of planned behaviour is alive and well, and not ready to retire: a commentary on Sniehotta, Presseau, and Araujo-Soares. Health Psychol Rev. **9**(2), 131–137 (2015)
20. Mirrielees, J.A., et al.: Breast cancer survivor advocacy at a university hospital: development of a peer support program with evaluation by patients, advocates, and clinicians. J. Cancer Educ. **32**(1), 97–104 (2017)
21. Umezawa, S., Fujisawa, D., Fujimori, M., Ogawa, A., Matsushima, E., Miyashita, M.: Prevalence, associated factors and source of support concerning supportive care needs among Japanese cancer survivors. Psychooncology **24**(6), 635–642 (2015)
22. Abras, C., Maloney-Krichmar, D., Preece, J.: User-centered design. In: Bainbridge, W. (ed.) Encyclopedia of Human-Computer Interaction. Sage Publications, Thousand Oaks (2004)
23. Preece, J., Rogers, Y., Sharp, H.: Interaction Design: Beyond Human-Computer Interaction. Wiley, New York (2002)
24. Qiu, J., et al.: Quality of life and psychological state in Chinese breast cancer patients who received BRCA1/2 genetic testing. PLoS ONE **11**(7), e0158531 (2016). https://doi.org/10.1371/journal.pone.0158531
25. Epstein, R.M., Street, R.L.: The values and value of patient-centered care. Ann. Fam. Med. **9**(2), 100–103 (2011). https://doi.org/10.1370/afm.1239
26. Satish, T., et al.: Care delivery impact of the COVID-19 pandemic on breast cancer care. JCO Oncol. Pract. **17**(8), e1215–e1224 (2021). https://doi.org/10.1200/OP.20.01062
27. Hu, J., et al.: Peer support interventions for breast cancer patients: a systematic review. Breast Cancer Res. Treat. **174**(2), 325–341 (2019). https://doi.org/10.1007/s10549-018-5033-2
28. Hou, I.-C., et al.: The development of a mobile health app for breast cancer self-management support in Taiwan: design thinking approach. JMIR MHealth UHealth **8**(4), e15780 (2020). https://doi.org/10.2196/15780