

Original Article

Evaluation of a whole process management model based on an information system for cancer patients with pain: A prospective nonrandomized controlled study



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ABSTRACT

Objective: The aim of this study was to evaluate the effects of whole process management model interventions based on information system benefits reported by patients with cancer pain.

Methods: We performed a quantitative, prospective nonrandomized controlled design from June to October 2020. A total of 124 cancer patients with pain were enrolled. Patients in the experimental group received a whole process management model intervention based on an information system compared to the control group who received routine cancer pain management. Data were collected at baseline and after a four-week follow-up, acting as a test-retest control. The primary outcome was pain management quality, which was measured using the American Pain Society Patient Outcome Questionnaire-Chinese version (APS-POQ-C). Secondary outcomes were patient-related attitudinal barriers and analgesic adherence. The Barrier Questionnaire (BQ) and a single-item questionnaire were used. Chi-square tests were used to compare the pain intensity and analgesic adherence, independent sample *t*-test and Mann–Whitney U test were performed to test the differences in the pain management quality and patient-related attitudinal barriers between control and experimental groups.

Results: Baseline characteristics and outcomes of the participants did not differ significantly ($P > 0.05$). Primary outcomes were changes in four aspect of the quality of pain management (APS-POQ-C) between the two groups ($P < 0.05$). Patients in the whole process management group reported significantly better pain control and perception of care than the control group. With respect to secondary endpoints, a significant difference in favor of the experimental group was found for barriers ($P < 0.05$) and medication adherence (60.0% vs. 40.0%; $P < 0.05$) after the interventions.

Conclusions: The whole process management of patients with cancer pain effectively improves patient-reported quality of pain management, reduces patient-perceived barriers, enhances patient adherence to analgesic drugs and is worthy of clinical application.

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Introduction

Pain is one of the most prominent symptoms faced by cancer patients. As early as 1986, the World Health Organization (WHO) issued guidelines for the treatment of cancer pain,¹ which provided a basis for standardized diagnosis and treatment of cancer pain. Despite increased attention to its assessment and management, pain continues to be a prevalent symptom in cancer patients. A published meta-analysis suggested that pain prevalence rates among cancer patients were substantial but variable: 39.3% reported pain following curative treatment, 55% during anticancer treatment, and 66.4% in advanced, metastatic, or terminal stages of the disease.² Furthermore, pain relief of outpatients with cancer pain is unsatisfactory.^{3–6}

In recent years, although palliative care centers providing standardized pain treatment have been established in many provinces and cities in China, compared to the growing population of cancer patients in China, they are still quite scarce.⁷ In addition, there are still many deficiencies in the standardized implementation of cancer pain assessment, treatment and nursing, including insufficient patient education and public education, misunderstanding and worry about opioid addiction and drug side effects, resulting in low compliance with analgesic drugs, and patients taking drugs not following the doctor's advice.⁸ For these reasons, good pain management outcomes in out-of-hospital scenarios are difficult to achieve.

Pain management has focused on information support and feedback from outpatients with pain now. In addition to telephone and home visit, online education focusing on pain and analgesic drug management has emerged to overcome patient-related barriers, and online consultation has emerged to strengthen communication between patients and health professionals through WeChat or email based on the popularization and application of electronic information technology.^{9,10} Olden Menger WH et al. further integrated the functions of different modules through an internet application that contained a pain diary, eConsult, and patient pain education and realized the online docking of patients and nurses to meet the different needs of patients with cancer pain.¹¹ Hochstenbach LM et al. confirmed the feasibility of mobile and web-based interventions to support self-management in outpatients with cancer pain by daily monitoring, graphical feedback, education, and advice by means of a mobile application for patients and a web application for nurses.¹² Regular follow-up of discharged cancer pain patients based on the electronic follow-up system effectively improved the degree of pain relief, medication compliance and satisfaction.^{13,14} The above out-of-hospital management models have provided some help for patients with pain after discharge, but there are still deficiencies, such as a lack of discharge referrals for cancer patients with pain, interruption of professional support for some patients, inability of follow-up health professional to formulate targeted follow-up plan, and lack of support of continuous diagnosis and treatment information in the evaluation and guidance of follow-up. The lack of admittance criteria and clear-cut job responsibility for follow-up resulted in hard to control follow-up efficiency, and a high missed follow-up rate occurs due to discontinuous follow-up after discharge.

The Symptom Management Theory (SMT) is a middle range model illustrating a multidimensional process of symptom management. It was initially published as the UCSF Symptom Management Model (SMM) in 1994 as a collaborative effort by members of the Symptom Management Faculty Group at the University of California at San Francisco School of Nursing.¹⁵ The updated versions of the UCSF Symptom Management Model were published in 2001,¹⁶ 2008 and was renamed the SMT.¹⁷ The SMT includes three components of symptom management: the symptom experience, symptom management strategies, and outcomes.¹⁶ The dimensions of nursing science, which the person, health and illness, and environment dimensions included, were added update to depict the context in which the symptom management process occurs.¹⁶

So far, no research finding of changing the current situation of disconnection between discharge and hospitalization for pain

management in recent reporting in China. Considering the important role of pain management and the lack of systematic pain management model, we aimed to address this issue. The progress of information management provided us new ideas for pain management, after referring to papers widely home and abroad about follow-up methods (models) for out-of-hospital management,^{9–14} the study build a new whole process management model of cancer pain patients from inpatient, to outpatient, to home, aimed to change the existing fragmented management model, and further improve the management connotation of each stage. Based on the SMT, the conceptual framework of the research was constructed (Figure 1). It was hypothesized that after the whole process management model interventions, thereby improving pain control, overcoming existing barriers and compliance with analgesic drugs in cancer patients with pain.

Methods

Study design

A quantitative, prospective nonrandomized controlled design was used to evaluate the effect of the whole process management model in cancer patients with pain. This study enrolled 124 patients undergoing cancer pain treatment with data collected from June to October 2020. This study was approved by the Beijing Cancer Hospital Ethical Committee (Approval No. 2019KT96).

Participants

This study was conducted in a grade three comprehensive cancer hospital in Beijing, China. Purposive sampling was used. One hundred and twenty-four patients were screened for this study (Figure 2). The inclusion criteria were 1) patients who were pathologically diagnosed with malignant tumors; 2) age ≥ 18 ; 3) requiring taking opioids orally to control the cancer pain; 4) voluntary participation in this study and signed informed consent; 5) and patients or their caregivers had smartphones. The exclusion criteria were 1) patients can not cooperate with the investigation due to physical weakness; 2) patients with pain caused by surgery; and 3) patients or caregivers who could not master the use of this follow-up information system after guidance. Drop-out criteria included 1) patients who died during the follow-up period; 2) patients with newly emerging major disease in addition to the cancer or chemotherapy side effects during the follow-up period and could not be followed up; 3) patients who received surgical treatment during the follow-up period; and 4) patients who stopped taking opioids for more than two weeks after discharge, because of the specificity of the treatment, such as patients received interventional therapy. The patients before implementation of the whole process management model were selected as the control group, and the patients after the implementation of the whole process management model were recruited as experimental group.

Research intervention

Nurse training

In order to ensure the homogeneity of the whole process of cancer pain management in all departments, the Nursing Department held head nurse and clinical nursing teaching staff meeting about the whole process management system and process at the hospital level. And then, head nurse and clinical nursing teaching staff trained the nurses in their own departments using the same courseware.

Pain management of the patient with cancer pain

Hospitalization: Both groups of patients received usual care during hospitalization, including pain screening, assessment and recording by the nurse; teaching patients to take analgesics correctly, prevent and observe adverse reactions of analgesic drugs; providing pain education;

and giving guidance for medical support services provided by pain clinic before discharge.

Discharge preparation:

For the patients in control group: the nurse told the patient to take analgesic on time after discharge. If the patient had any problems about pain that cannot be solved at home, they would go to the pain clinic for treatment.

For the patients in experimental group: (1) the whole process management information system was developed and constructed by Nursing Department and Information Center. The functional modules of the whole process management model are detailed in Figure 3. Nurses completed the discharge preparation and out-of-hospital management through the system. The components of the whole process management model are detailed in Figure 4. (2) A comprehensive pain assessment was performed and patients with pain were referred to the pain clinic through the system before discharge by a charge nurse. (3) Beizhouyun medical records is an application developed by the hospital. It is used for registered patients to make an appointment for examination, on-line follow-up, medical record management and so on. Pain management is one of the application programs that serves as the patient terminal for the whole process management. Then, the Nursing Department has developed a brochure for patients' use of pain management application. Before the patients were discharged from the hospital, the charge nurse guided the patients to download the beizhouyun medical records face to face in the ward according to the brochure, and told the patients how to use the pain management program, including completing pain diaries, online consultations and online learning. In the case of patients without smart phones, we would also conduct synchronous training for the main caregivers who use smart phones, and issue the brochures for patients and their families to further review.

Out-of-hospital management:

- (1) A trained nurse handled follow-up through information system for cancer patients with pain whose main responsibilities were as follows:

- I. Perform follow-up on schedule, including receiving patients referred from the ward, checking the pain assessment records before discharge, and making the follow-up plan. Patients with pain intensity measured by NRS score >3 and/or 24-h breakthrough pain >3 times in the past 24 h were scheduled for telephone follow-up within 3 days, and patients with stable pain control were scheduled within seven days. Follow-up records were generated.
 - II. Early warning follow-up. The information system had a set threshold value of early warning, such as NRS score of basic pain intensity >3 points and/or 24-h burst pain >3 times and/or serious adverse reaction of opioids in the pain diary uploaded by patients at home. The system sends an automatic reminder, and then the nurses call the patient in a timely manner, perform a comprehensive assessment, identify the problems and provide advice.
 - III. The nurse checked the eConsult module every day, combined with the patients' pain diary and follow-up records and answered questions related to pain management in a timely manner online while the patient was at home.
 - IV. According to common pain-related problems identified during follow-up, online pain education materials were made available for all patients. The primary topics included how to use the NRS scale to evaluate pain intensity, common analgesic drugs and precautions, identification and treatment of common adverse reactions to opioids, such as constipation, nausea and vomiting, common nondrug interventions, common concerns and misconceptions related to pain treatment, etc.
- (2) Cancer patients with pain at home can use a pain management program on their mobile phones to report their pain and communicate with medical staff.
 - I. Pain diary: Patients with unstable pain control were encouraged to keep the pain diary every day. If the pain intensity, the number of breakthrough pain occurrences and the side effects

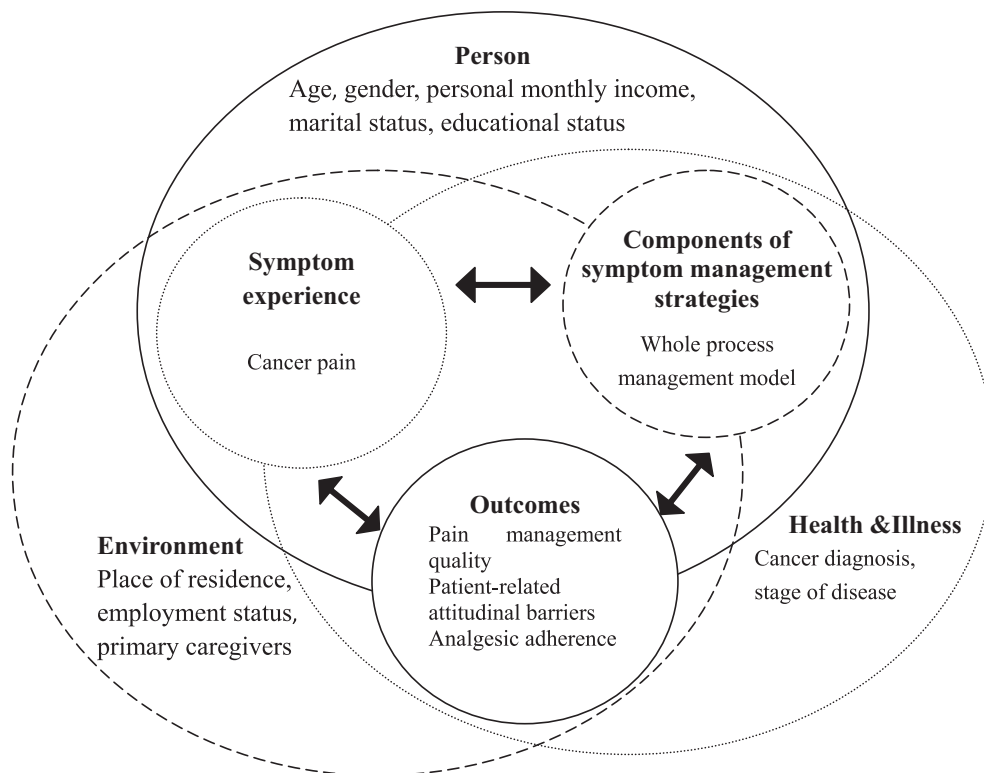


Figure 1. Conceptual framework for the study of evaluating a whole process management model.

in the pain diary exceeded the warning threshold, a follow-up by the nurse was performed in a timely manner.

- II. Online consultation: If cancer patients with pain had pain-related problems at home, they can consult the pain specialist nurse through the eConsult module online.
- III. Pain education: Patients were encouraged to check and learn pain self-management knowledge through the pain education module on their mobile phones.

Operationalization and measurement of variables

The survey was divided into two parts. The first part was demographic and clinical data, including age, gender, place of residence, employment status, personal monthly income, marital status, educational status and primary caregiver. Cancer diagnosis and stage information were extracted from the medical records.

The second part was instruments for outcomes. The primary outcome was pain management quality, which was measured using the American Pain Society Patient Outcome Questionnaire-Chinese version (APS-POQ-C). High-quality pain management is defined as having several features,

appropriate ongoing assessment, interdisciplinary, collaborative care planning that includes patient input; appropriate treatment that is efficacious, cost-conscious, culturally and developmentally appropriate, and safe; and access to specialty care as needed were all included.¹⁸ Secondary outcomes were patient-related attitudinal barriers and analgesic adherence. Patient-related attitudinal barriers based on misinformation or misconceptions in cancer pain and its management are viewed as critical barriers.¹⁹ Barrier Questionnaire (BQ) was used for measurement of patient-related attitudinal barriers. The WHO defines adherence to long-term therapy as “the extent to which a person’s behavior—taking medication, following a diet, and/or executing lifestyle changes—corresponds with agreed recommendations from a health care provider”.²⁰ In this study, analgesic adherence was surveyed by a single-item questionnaire.

The American Pain Society Patient Outcome Questionnaire (APS-POQ) was developed in 1991²¹ and revised twice.¹⁸ The latest version of the APS-POQ was released in 2010. The APS-POQ-R is a validated instrument designed for use in adult hospital pain management quality improvement activities. Yu WH²² translated this version into Chinese (APS-POQ-C) to investigate pain management quality in Chinese patients

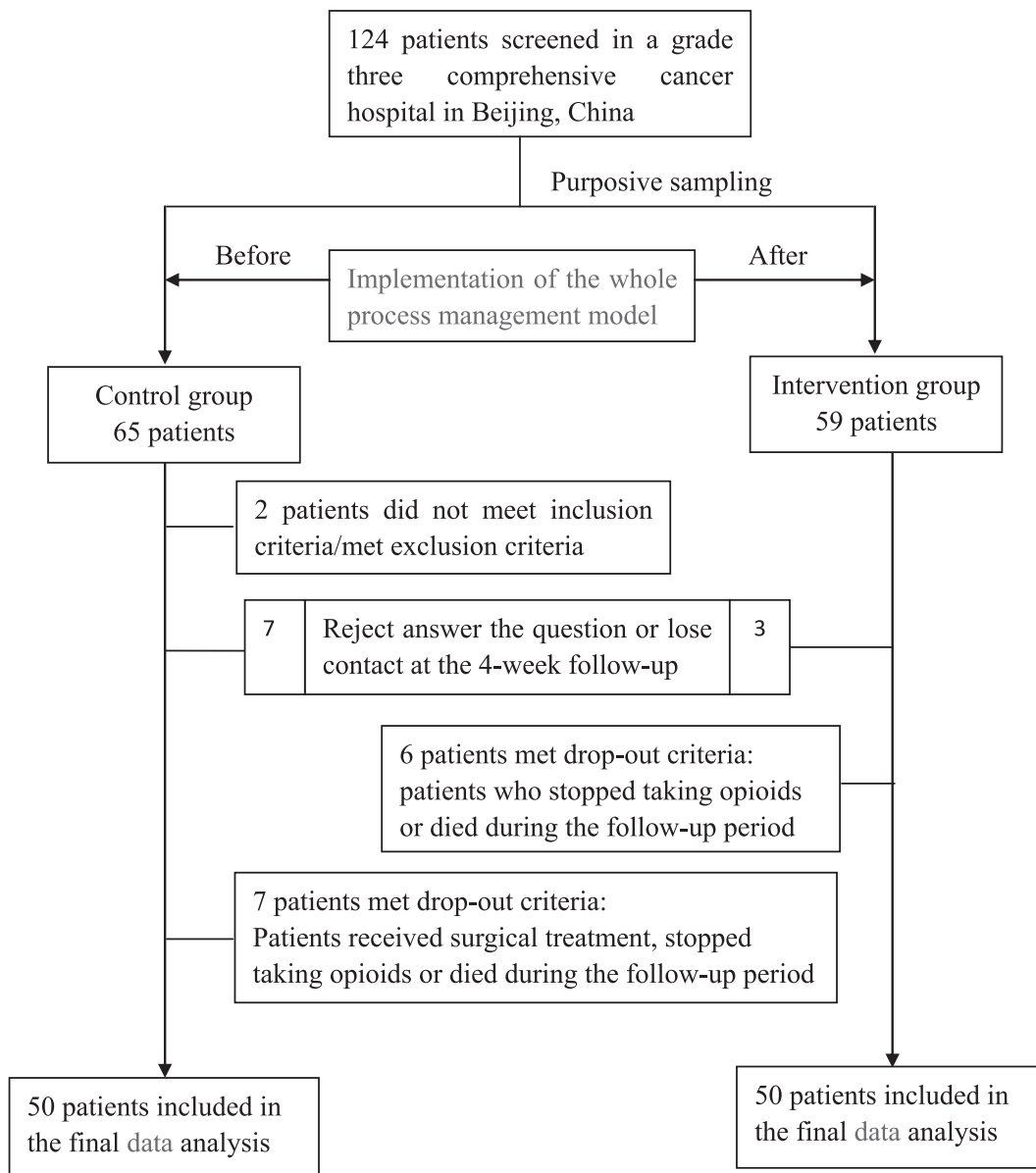


Figure 2. Flow chart of patients enrolled in the study.

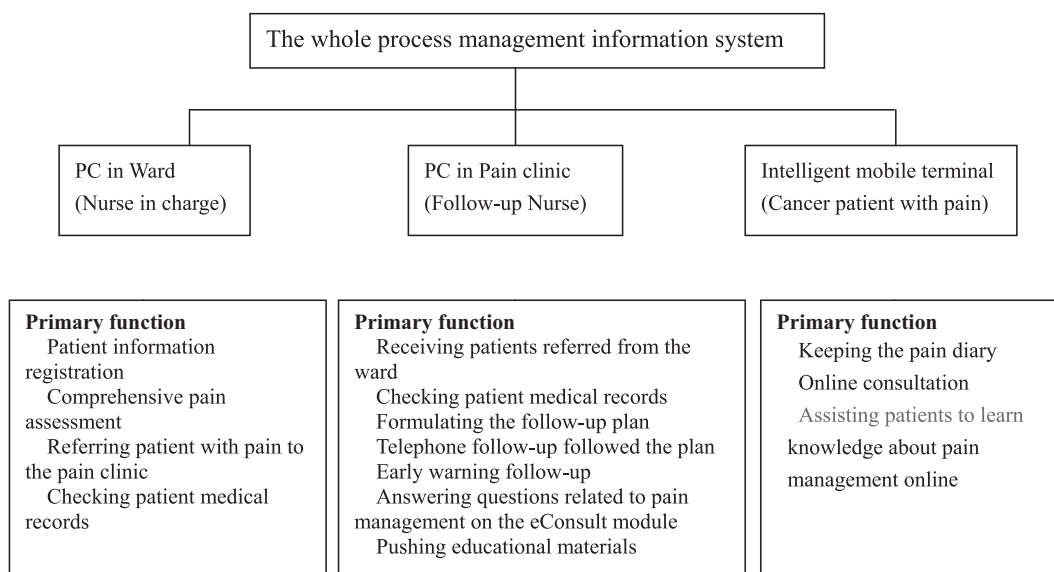


Figure 3. Functions of the whole process management information system.

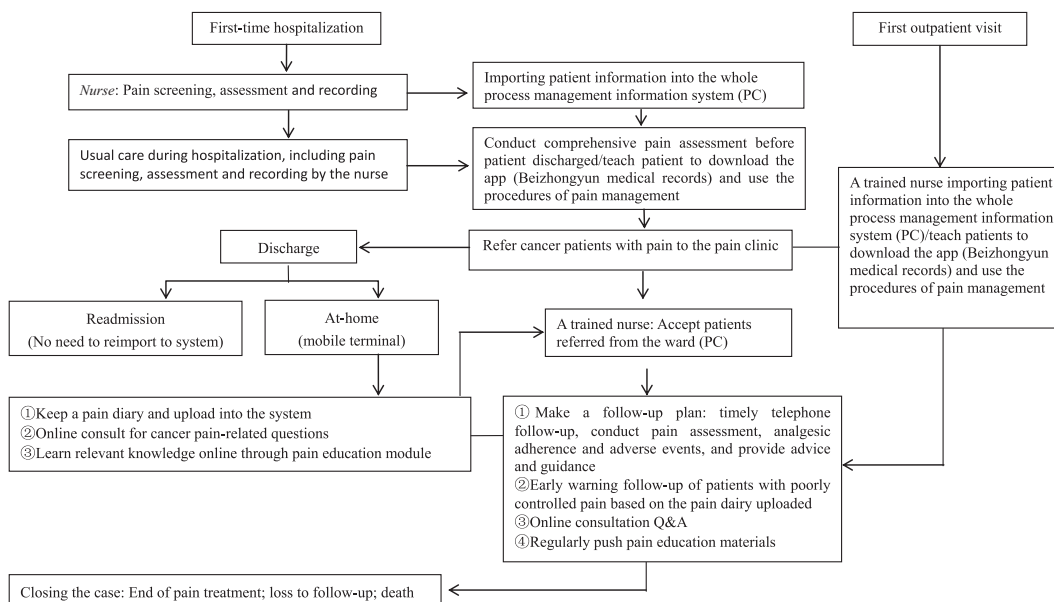


Figure 4. The whole process management model for cancer patients with pain.

with cancer pain. The questionnaire consists of 21 items (18 core items) using 0–10 numeric rating scales. It measures 6 dimensions of quality, including pain intensity, sleep interference, activity interference, affective experiences (emotional), pain management-related side effects and perception of pain care. Testing in 153 patients supported the internal consistency of instrument subscales and construct validity (Cronbach α of 0.735). The total content validity of the scale was 0.98, and the content validity of each item ranged from 0.82 to 1.00.

Patient-related attitudinal barriers were measured using the Barriers Questionnaire-Chinese (BQ-C). The Barriers Questionnaire is a 27-item self-reported instrument developed by Ward and her colleagues²³ in 1993 designed to measure the extent to which patients endorse eight beliefs about reporting cancer pain and using analgesics, which act as barriers to pain management. Items are rated using 0 (do not agree at all) to 5 (agree very much) Likert scales. Subscale and total BQ-C scores, calculated as the means of the individual items, range from 0 to 5. The higher the score, the more negative the beliefs were. Lu YH²⁴ translated

this scale into Chinese to investigate patient-perceived barriers in China. Some factors involved were not considered to be barriers by Chinese patients because of Chinese culture and drug control policies or strategies, so the instrument was adapted to 10 items. The validity and reliability of the BQ and the BQ-C are both well established.

A single self-reported item was used to investigate analgesic adherence. Analgesic adherence was identified if patients regularly took opioids following prescriptions. Nonadherence behaviors included forgetting to take the medicine, taking a lower/higher dose of the medicine than recommended, and discontinuing the medicine without orders within two weeks.

Procedures

Pain intensity was the primary outcome of this study. Agboola et al.²⁵ found that the difference in the average pain score between the experimental group and the control group was 1.5 points, and the standard

deviation of the average pain score was 2.5 points. According to the sample size calculation formula, $N = [Z\alpha / 2 + Z\beta] \sigma / \delta]^2$, $\alpha = 0.05$, and power of test $(1-\beta)$ 80%, the sample size was equal to approximately 44. Considering the inefficiency of 20%²⁵ of the questionnaires, the minimum sample size was 55 in each group.

Data collection

The investigators explained in detail the purpose of this study and obtained informed consent from all participants. For patients who agreed to participate in this study but did not have or know how to use smart phones, we explained in detail and obtained informed consent from the primary caregivers (A. daily care duration ≥ 4 h; B. continuous care > 1 month after discharge). Data were collected at two time points, the day before the first discharge after inclusion in the study and at the 4-week follow-up. The questionnaires were completed independently by patients, except for disease-related information, which was completed by the researchers after referral to the medical records. Considering the impact of COVID-19, the investigators contacted the patients by telephone to ask the patients to complete the questionnaires after 4 weeks of follow-up. If the patient couldn't participate in the face-to-face investigation, with the permission of the patient, the investigator asked the patient about the content of the questionnaire and filled in the options that the patient answered. When the patient's contact information was changed, the investigator found the patient by contacting the primary caregiver, but the primary caregiver did not participate in the answering process. If greater than 10% of the options were not filled out, the results were considered invalid.

Data analysis

Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 19.0. Descriptive statistics were used to describe the demographic characteristics and study variables based on the level of measurements. Chi-square tests and Fisher's exact test were used to compare control and experimental group-related participant characteristics and counting data of outcomes. The quantitative data of outcomes were tested for normality prior to the statistical analysis. Independent sample *t*-test was used to examine differences between the control and experimental groups at baseline and after the intervention. If the data belonged to non-normal distributions data, P50 (P25, P75) were used to describe the distribution of the data, Mann–Whitney U test was performed for analysis among groups at the two measurement points.

Results

Participant characteristics

The total number of participants who were surveyed at the first point was 124, and the final sample of 100 participants recruited (Table 1), with a completion rate of 80.65%. Completion rates among the experimental and control groups were 84.75% (50/59) and 76.92% (50/65), respectively. The average age of the participants was 58.10 years, with a standard deviation of 10.18 years, and 64 were men (64.0%). Fifty participants received whole process pain management, and 50 participants served as a control group. An overview of each group is described in Table 1.

Pain management quality

There were no differences between pain intensity in the control and experimental groups before the intervention ($\chi^2 = 0.367$, $P = 0.545$) [Table 2]. After the intervention, the Chi-squared test demonstrated that there was a significant difference between the two groups ($\chi^2 = 10.928$,

Table 1
Participant characteristics (N = 100).

Characteristics	Experimental group	Control group	t/χ^2	P
Age [years, mean \pm SD (Min–Max)]	56.32 \pm 10.21 (39–72)	59.88 \pm 9.93 (28–84)	1.767	0.080 ^b
Gender			2.778	0.096 ^a
Female	22 (44.0)	14 (28.0)		
Male	28 (56.0)	36 (72.0)		
Cancer diagnosis			8.296	0.212 ^c
Lung cancer	26 (52.0)	19 (38.0)		
Esophageal cancer	3 (6.0)	3 (6.0)		
Gastric cancer	5 (10.0)	6 (12.0)		
Hepatobiliary and pancreatic cancer	8 (16.0)	7 (14.0)		
Colorectal cancer	3 (6.0)	7 (14.0)		
Head and neck cancer	0 (0.0)	5 (10.0)		
Others	5 (10.0)	3 (6.0)		
Stage of disease			2.216	0.647 ^c
I	0	2 (4.0)		
II	1 (2.0)	2 (4.0)		
III	6 (12.0)	5 (10.0)		
IV	43 (86.0)	41 (82.0)		
Local city			0.053	0.817 ^a
Yes	38 (76.0)	37 (74.0)		
No	12 (24.0)	13 (26.0)		
Employment status			5.916	0.052 ^a
Employed	16 (32.0)	6 (12.0)		
Unemployed	9 (18.0)	13 (26.0)		
Retired	25 (50.0)	31 (62.0)		
Personal monthly income			3.401	0.334 ^a
$< \text{¥} 1000$	12 (24.0)	15 (30.0)		
$\text{¥} 1000\text{--}4999$	26 (52.0)	22 (44.0)		
$\text{¥} 5000\text{--}9999$	8 (16.0)	12 (24.0)		
$\geq \text{¥} 10,000$	4 (8.0)	1 (2.0)		
Marital status			1.604	0.678 ^c
Unmarried	0	1 (2.0)		
Married	46 (92.0)	47 (94.0)		
Divorced/Widowed	4 (8.0)	2 (4.0)		
Education			2.054	0.726 ^a
Primary school or less	7 (14.0)	5 (10.0)		
Junior high school	13 (26.0)	14 (28.0)		
Senior high school	14 (28.0)	17 (34.0)		
Junior college	7 (14.0)	9 (18.0)		
College or greater	9 (18.0)	5 (10.0)		
Primary caregivers				0.617 ^c
Immediate family	47 (94.0)	49 (98.0)		
Nonimmediate family	3 (6.0)	1 (2.0)		

^a Chi-square test.

^b Independent sample *t*-test.

^c Fisher's exact test.

Table 2
Comparison of pain intensity pre- and postintervention.

Pain intensity	Preintervention [n (%)]		Postintervention [n (%)]	
	Complete pain relief	Incomplete pain relief	Complete pain relief	Incomplete pain relief
Experimental group (n = 50)	20 (40.0)	30 (60.0)	43 (86.0)	7 (14.0)
Control group (n = 50)	23 (46.0)	27 (54.0)	28 (56.0)	22 (44.0)
χ^2	0.367		10.928	
P	0.545		0.001	

Complete pain relief was defined as 0–3 points (Numerical Rating Scale, NRS) average pain and ≤ 3 times breakthrough pain in the past 24 h.

$P = 0.001$) [Table 2]. Independent sample *t*-test or Mann–Whitney U test was used for the other aspects of the APS-POQ-C. In both the control and experimental groups, the mean score of each aspect ranged from 1.66 (SD = 1.61) to 5.29 (SD = 1.81). There were no differences between the

Table 3
Comparison of interference with function, affective experiences, side effects and perceptions of care pre- and postintervention.

	Preintervention (mean ± SD)	<i>t</i> ^a	<i>P</i>	Postintervention ^b [P50 (P25, P75)]	<i>Z</i> ^c	<i>P</i>
Sleep interference		0.000	1.000		-2.853	0.004
Experimental group (n = 50)	3.33 ± 2.51			0.00 (0.00, 0.00)		
Control group (n = 50)	3.33 ± 2.46			0.00 (0.00, 2.25)		
Activity interference		0.362	0.718		-1.490	0.136
Experimental group (n = 50)	3.53 ± 2.14			0.00 (0.00, 1.00)		
Control group (n = 50)	3.70 ± 2.54			0.00 (0.00, 2.63)		
Affective experiences (emotional)		0.811	0.419		-4.691	0.000
Experimental group (n = 50)	3.35 ± 2.27			0.00 (0.00, 0.50)		
Control group (n = 50)	3.72 ± 2.29			1.38 (0.00, 3.31)		
Side effects		-0.391	0.697		-1.712	0.087
Experimental group (n = 50)	1.77 ± 1.28			0.60 (0.00, 1.35)		
Control group (n = 50)	1.66 ± 1.61			1.10 (0.30, 1.80)		
Perceptions of pain care		-1.094	0.277		-5.077	0.000
Experimental group (n = 50)	5.29 ± 1.81			6.25 (4.94, 7.56)		
Control group (n = 50)	4.87 ± 2.03			4.00 (3.00, 5.00)		

^a The pre-intervention data accorded with normal distribution, independent sample *t*-test was performed.

^b the post intervention data belonged to non-normal distributions data, P50 (P25, P75) were used to describe the distribution of the data.

^c Mann-Whitney U test was performed.

two groups before intervention ($P > 0.05$). After the intervention, the Mann-Whitney U test found that there were differences in three aspects between the two groups [Table 3].

Patient-related attitudinal barriers

In both the control and experimental groups, the scores of patient-related attitudinal barriers toward cancer-related pain were 2.25 (1.38, 3.30) and 1.65 (0.98, 3.03), respectively ($Z = -1.386, P = 0.167$). After

the intervention, the Mann-Whitney U test found that there were differences between all items as well as the total BQ-C score between the two groups [Table 4].

Analgesic adherence

After the intervention, more than half of patients (60.0%) took analgesics in complete order in the experimental group, which was different from the control group (40.0%) [Table 5].

Table 4
Comparison of each item of patient-related attitudinal barriers to pain management pre- and postintervention.

	Preintervention [P50 (P25, P75)]	<i>Z</i> ^a	<i>P</i>	Postintervention [P50 (P25, P75)]	<i>Z</i> ^a	<i>P</i>
Uncontrol		-0.068	0.950		-4.686	0.000
Experimental group (n = 50)	3.00 (0.00, 4.00)			0.00 (0.00, 0.00)		
Control group (n = 50)	3.00 (0.00, 4.25)			0.50 (0.00, 4.25)		
Addiction		-1.863	0.063		-3.452	0.000
Experimental group (n = 50)	3.00 (0.00, 4.00)			0.00 (0.00, 2.00)		
Control group (n = 50)	0.00 (0.00, 4.00)			3.00 (0.00, 5.00)		
Side effects		-0.881	0.382		-3.728	0.000
Experimental group (n = 50)	3.00 (0.00, 4.00)			0.00 (0.00, 2.00)		
Control group (n = 50)	2.00 (0.00, 4.00)			3.00 (0.00, 5.00)		
Physiological dependence		-1.253	0.212		-2.252	0.031
Experimental group (n = 50)	2.00 (0.00, 4.00)			0.00 (0.00, 0.00)		
Control group (n = 50)	3.00 (0.00, 4.00)			0.00 (0.00, 0.00)		
Pain endurance		-1.451	0.147		-2.708	0.007
Experimental group (n = 50)	3.00 (0.00, 4.00)			0.00 (0.00, 2.00)		
Control group (n = 50)	2.00 (0.00, 4.00)			2.00 (0.00, 4.00)		
Be good patients		-0.871	0.387		-3.248	0.001
Experimental group (n = 50)	3.00 (1.75, 5.00)			0.00 (0.00, 0.00)		
Control group (n = 50)	3.00 (0.00, 5.00)			0.00 (0.00, 1.25)		
Tolerance		-1.024	0.310		-3.491	0.001
Experimental group (n = 50)	3.50 (2.00, 5.00)			0.00 (0.00, 0.00)		
Control group (n = 50)	3.00 (0.00, 5.00)			0.00 (0.00, 0.00)		
Distraction of physicians		-1.247	0.216		-2.667	0.008
Experimental group (n = 50)	0.00 (0.00, 2.00)			0.00 (0.00, 0.00)		
Control group (n = 50)	0.00 (0.00, 0.50)			0.00 (0.00, 0.00)		
Availability of opioids		-0.166	0.871		-2.620	0.008
Experimental group (n = 50)	0.50 (0.00, 5.00)			0.00 (0.00, 2.00)		
Control group (n = 50)	1.50 (0.00, 5.00)			1.50 (0.00, 4.00)		
Economic worries		-0.665	0.510		-2.282	0.023
Experimental group (n = 50)	0.00 (0.00, 2.00)			0.00 (0.00, 0.00)		
Control group (n = 50)	0.00 (0.00, 3.00)			0.00 (0.00, 0.00)		
Total BQ-C score		-1.386	0.167		-5.493	0.000
Experimental group (n = 50)	2.25 (1.38, 3.30)			0.40 (0.08, 0.80)		
Control group (n = 50)	1.65 (0.98, 3.03)			1.35 (0.70, 2.03)		

^a Mann-Whitney U test.

Table 5
Comparison of analgesic adherence pre- and postintervention.

Analgesic adherence	Preintervention [n (%)]		χ^2 ^a	P	Postintervention [n (%)]		χ^2 ^a	P
	Adherence	Nonadherence			Adherence	Nonadherence		
Experimental group (n = 50)	22 (44.0)	28 (56.0)	0.372	0.542	30 (60.0)	20 (40.0)	4.000	0.046
Control group (n = 50)	19 (38.0)	31 (62.0)			20 (40.0)	30 (60.0)		

^a Chi-square test.

Discussion

In China, current pain management focuses on management during hospitalization. The relevant needs of pain management of patients after discharge cannot be met due to remote residence, difficulties in seeking medical treatment due to COVID-19, and the lack of pain management professionals in community health centers.

The whole process management model based on the information system had the following advantages. First, reasonably using mobile nurse stations and electronic nursing systems changed the current situation of disconnection between discharge and hospitalization for pain management. Furthermore, coupled with management processes and regulations protection, the model provided an efficient and convenient path for whole process management. Second, nurses in wards performed the pain screening, assessment, and recording before the referral of cancer patients with pain from hospitalization to discharge, and follow-up nurses at the pain clinic can complete the comprehensive evaluation and follow-up records of patients by relying on structured forms. Finally, it solved the problems existing in routine follow-up; for example, the process was not standardized, the content was not unified, and it was easily restricted by objective factors, such as human and material resources. Follow-up nurses are professionally trained, familiar with the principles of cancer pain treatment and have rich experience, so they can provide professional guidance for cancer patients with pain.

Compared to the traditional pain management model, the whole process pain management model improved the quality of cancer pain management. The results showed that the number of patients whose pain was effectively alleviated increased, interference with affective experiences (emotional) decreased, and significantly attenuated pain during patient sleep compared to the control group. Luckett T's findings suggested that an optimal self-management resource should encourage pain reporting, build patients' sense of control, and support communication with providers and coordination between services.²⁶ In the present study, the planned and early warning follow-up performed by professional nurses, along with comprehensive evaluation and professional guidance based on structured forms of information system, fully mobilized the self-management efficiency of patients, promoted the timely and comprehensive reporting of pain, and enabled corresponding intervention as soon as possible for pain treatment. Therefore, the whole process management model can identify problems such as the unsatisfactory use of pain control drugs, delay of receiving treatment, and unwillingness to report pain to solve the problem of insufficient pain control and improve the pain management outcome of patients. The results also confirmed that the whole process management model effectively improved patients' perception of care and satisfaction with pain management. Patients appreciate the concept of people-oriented nursing after sufficient communication, support and feedback between nurses and patients.

This study confirmed that whole process management effectively eliminated patient concerns about pain and pain treatment, enabling them to approach pain treatment with a more positive attitude and improve compliance to analgesic drugs through pain assessment and education. Numerous barriers can hamper cancer patients' ability to manage their pain. These barriers can be related to healthcare professionals, the patient, or the health care system.¹⁹ The most important factor was misperceptions and beliefs of patients and their family members regarding analgesic drugs.^{27,28} Significance of results in Chinese cancer patients' and caregivers' was also observed with respect to

misconceptions regarding pain and analgesics, barriers about fear of addiction and concerns about analgesic side effects and disease progression.²⁹ In this study, the top one belief in scoring were tolerance in all patients, coinciding with that obtained by a cross sectional study of patient-related attitudinal barriers in Chinese cancer inpatients,³⁰ confirmed that patients worried that the analgesics would not work, and that they would become addicted with increasing doses and long-term use of it. After the interventions, patients' beliefs were all improved. Notably, the barriers about fear of addiction, side effects, pain endurance and availability of opioids decreased in the experimental group. Contrast, the scores of these items unchanged or even elevated in the control groups. Because the content of the assessment included the assessment of patient concerns about pain treatment and provided the basis for the early detection of pain control disorders. And, patient education was limited not only to unilateral education in the hospitalization stage but also throughout the whole process of pain treatment. Assessment and guidance on the telephone follow-up and online consultation realizes one-on-one counseling, so the education achieved individualization in real-time. The pain diary provided additional space for patients to actively report their own pain, and the education empowered patients. In the patient education module, continuity of support was more directly provided, and education using pictures and videos realized diversification. Multimedia-based programs may also be more engaging and interactive than traditional interventions and may allow personalization of the information received, which may be critical for a patient-centered approach to education and symptom management.³¹ Our findings lead us to conclude that a positive association was found between total BQ-C scores and patients' adherence. After knowing that the current standard of pain treatment and there was no need to worry about the availability of opioids, the patients' adherence has been effectively improved. To gain more insight, qualitative research methods may help to better explain the relationship between the two outcomes.

Limitations

This study has several limitations. First, these data was drawn from a sample of all patients undergoing a whole process management intervention, which were samples from kinds of solid cancers, the results cannot be generalized to all cancer patients. Second, we realize that this kind of symptom monitoring is not possible for all patients because not everyone has access to the internet. Therefore, teaching patients to download and use the app was seen as a part of the model. Third, the instruments were self-administered but asked by investigators at the second point due to COVID-19. The last, the comparison of the analgesic adherence post intervention was in the edge of insignificance. More reproducible results from more samples will help to increase the credibility.

Conclusions

The study preliminarily proved the whole process management model based on an information system effectively improves patient-reported quality of pain management, reduces patient-perceived barriers, enhances patient adherence to analgesic drugs and is worthy of clinical application. This research will be further extended to the clinical wards in the whole hospital, and it will be applied to newly diagnosed cancer pain patients in the outpatient department to verify the efficacy of the

model to allow more cancer pain patients to benefit from it.

Declaration of competing interest

None declared.

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