

Article

Clinical decision support for whole-course management of tumors: A quasi-experimental, pre-post design with a non-equivalent control group

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Abstract: Background: Cancer is the number one threat to human health and a disease burden worldwide. However, cancer patients still face many challenges in the diagnosis and treatment process, and therefore, the establishment of an efficient whole-course oncology management model to improve the efficiency of diagnosis and treatment and the quality of patient management has become an urgent issue to be solved. **Methods:** The aim of this study was to evaluate the feasibility of the constructed high-precision whole-course management platform for tumors. By using the method of random sampling, cancer patients diagnosed in our hospital from February 2022 to February 2023 were taken as the control group, and those diagnosed in our hospital from March 2023 to March 2024 were taken as the intervention group, with 147 cases in each group. The control group adopted conventional cancer management. The intervention group adopted applet as the carrier to complete the whole-course management of disease screening, diagnosis, treatment, and rehabilitation. After discharge, patients were followed up regularly for 1 month, 3 months, and 6 months. The diagnosis and treatment efficiency, hospitalization cost, side effects, and prognosis of patients in different groups were observed. **Results:** The average waiting time from screening to hospitalization, length of hospitalization, and cost were significantly shorter in the intervention group than in those in the control group ($P < 0.05$). The objective remission rate in the intervention group (45.26%) showed an upward trend compared to the control group (38.52%) ($P > 0.05$). Compared with the control group, the side effects such as radiodermatitis, lymphoedema on the affected side, bone marrow suppression, hepatic impairment, and gastrointestinal damage caused during the treatment process in the intervention group were also significantly alleviated ($P < 0.05$). The medication adherence and rehabilitation adherence of patients in the intervention group were higher than those in the control group at 1, 3, and 6 months after discharge ($P < 0.05$). Compared with the control group, the anxiety and depression were significantly improved in the intervention group 3 and 6 months after discharge ($P < 0.05$). The quality of life score of the intervention group was significantly better than that of the control group six months after discharge ($P < 0.05$). **Conclusion:** The whole-course management model is a high-quality, low-cost, and efficient healthcare service model, which can shorten the average hospital stay and hospitalization costs of cancer patients, improve the efficiency of diagnosis and treatment and the quality of patient management, as well as improve side effects and quality of life. However, the application of this management model in all aspects is still not mature, and indicators and management systems are needed to form a standard database and knowledge base system.

Keywords: whole-course management of tumors; diagnostic and therapeutic efficiency; side effects; quality of life; length and cost of hospitalization

1. Introduction

Tumors have always been a major problem plaguing humanity and are known as the ‘number one problem’ threatening human health. In recent years, the disease burden of malignant tumors has increased rapidly worldwide, and CONCORD-3 data show that the 5-year survival rates of malignant tumors in China, Japan, and the United States are 36.0%, 57.4%, and 64.0%, respectively [1]. With the advent of the era of precision therapy and immunotherapy, the survival period of cancer patients has gradually prolonged, and the trend of coexisting with cancer and slowing down cancer has gradually become a consensus [2]. Therefore, how to better serve the early screening, early diagnosis, accurate classification, treatment selection, prognosis prediction, and intelligent follow-up of clinical tumors and further improve the treatment effect of Chinese patients with malignant tumors is a challenging issue facing every clinical oncology medical worker [3].

With the increasing awareness of early screening and the continuous advancement of new guidelines related to early screening and early diagnosis, the treatment of cancer has been greatly improved. Taking lung cancer as an example, which has the highest morbidity and mortality in the world and in China [4,5], the 5-year survival rate of lung cancer in China has increased from 16.1% (2003–2005) to 19.7% (2012–2015) [6], but about 75% of lung cancer patients are still diagnosed in advanced stages and therefore miss the best treatment [7]. For these patients, who are often transferred to multiple medical institutions, the use of drugs, surgery, pathology, underlying diseases, and comorbidities is the key to making the next treatment plan during the long diagnosis and treatment process. However, with so much information, it is often difficult to simply rely on the provision of patients and their families or rely on the writing of paper medical records to meet the needs of doctors and patients for good and effective interaction. Therefore, refined, standardized, efficient, and traceable information management is expected to solve the above problems [8].

In addition, with the arrival of the era of big data and the update and development of medical concepts, intelligent diagnosis and treatment of diseases has gradually become the trend of the times [9], and it is imminent to build a full-network tumor management system integrating education, screening, diagnosis, treatment, and follow-up [10]. In this era, many scholars use information technology platforms to make decisions about clinical diagnosis and management. Cooley et al. integrated a clinical decision support system into the treatment of lung cancer and improved pain, dyspnea, and anxiety, but not patient outcomes [11]. Park et al. developed a clinical decision support system (CDSS) for the prognostic management of radical prostatectomy and found that prostate cancer trajectory mapping was effective for the prognostic management of radical prostatectomy. It optimized the visualization of patient data and enabled clinicians to access patient data in time, thereby improving patient outcomes [12]. However, so far, there are still gaps in the efficient extraction of clinical information and its application in clinical decision support systems, especially the lack of evidence to evaluate the application of text data mining and clinical decision support in cancer research. The whole process management of oncology is a new concept and treatment strategy in the diagnosis and treatment of oncology patients, which runs through the whole process from diagnosis to

rehabilitation. It is upgraded from simple patient management to the whole process management of disease and health management [13], including prevention guidance, early screening, diagnosis, comprehensive treatment, and rehabilitation guidance for susceptible populations and a series of intervention and guidance measures for hospice care, aiming to give cancer patients comprehensive, systematic, effective treatment and supervision management, improve the quality of life of patients, and prolong the survival time [14].

This study aimed to construct a cancer risk self-assessment system and establish a high-precision platform for the whole management of tumor diseases to achieve the purposes of tumor disease screening, feature monitoring, efficacy evaluation, and life outcome tracking and to provide a scientific basis for the development of cancer prevention and control strategies.

2. Material and methods

2.1. Tools

Development of a platform for whole-course management of oncology patients

Establishment of a research team

The project team members came from medical records, nursing, information, clinical, cancer control, prevention, and health care departments. They had strong practical experience and communication skills, which provided a guarantee for the practice of the project. There were 2 members with master's degrees and 7 with bachelor's degrees. There were 3 senior professional titles, 4 intermediate titles, and 2 junior titles.

Establishing a cancer risk self-assessment system

The cancer risk self-assessment system was developed based on the National Cancer Center's tumor risk assessment model. In the early stage, the user of the system scanned the code to guide residents to register in the form of community screening and popular science, and then the system automatically launched the cancer risk assessment scale. After the user completed the form, the risk level was returned through the intelligent evaluation algorithm in the background. The system provided primary screening and notification of test results to high-risk populations and proposed personalized early screening recommendations. High-risk patients were sent to the hospital for accurate diagnosis, and treatment recommendations were given according to the diagnostic results, and patients were included in the whole process of tumor management.

Establishing a population- and hospital-based platform for whole-course management of tumors

(1) The B/S architecture was used in the background of tumor whole-process management. The system mainly realized the establishment and maintenance of tumor standard data sets, doctor information management, patient whole-process data management, scientific research and analysis, data interface, and intelligent push. The whole data of the patients were collected through the data interface, and the data of the patients were transferred to the hospital. The whole process data of patients were

automatically obtained from HIS, LIS, PACS, EMR, and other systems through the secure front-end computer docking with the hospital integration platform. Through the process of data cleaning, later structuring, data quality control, data attribution, and other processes, accurate patient whole-process health records were generated to ensure the accuracy of research data in the later stage of the study.

(2) The applet was used as the carrier for the whole disease process of the oncologist, and the system mainly realized the whole process management of screening objects and enrolled patients. Doctors could classify and group patients for personalized management. Through the system, doctors could access patients' in-hospital and out-of-hospital data, view patients' complete health records on their phones, and respond to online consultations and customize follow-up plans.

(3) The applet was used as the carrier in the patient side of the whole disease process of oncology, and the system mainly realized the whole process management of the audience from guiding tumor prevention, early screening, in-hospital diagnosis, comprehensive treatment, post-diagnosis follow-up to the end of the disease. Through the intelligent push system of the platform, personalized science education, medication reminders, intelligent follow-up, dietary advice, follow-up reminders, and lifestyle intervention were pushed in combination with patient enrollment and disease stage. The platform regularly cooperated with doctors to carry out activities such as live patient education and online volunteer clinics, and patients can also consult doctors or AI online, record their conditions, and make appointments to visit hospitals.

(4) Based on the model of knowledge graph technology, the system-level phenotype omics map and the molecular-level multi-omics map of tumor diseases were constructed. Combined with the key technologies of big data and AI, an AI-assisted diagnosis and treatment decision-making system for malignant tumors was constructed by designing a reasoning machine based on distributed database architecture and taking the bus information integration and exchange as a means, forming a standard database and knowledge base system.

2.2. Participants

Tumor patients diagnosed and treated in our hospital from February 2022 to February 2023 were selected as the control group, and tumor patients diagnosed and treated from March 2023 to March 2024 were selected as the intervention group. A total of 294 cancer patients were collected in this study, including 12 cases discharged from the control group and 10 cases discharged from the intervention group. Finally, 135 cases in the control group and 137 cases in the intervention group were included in the study, as displayed in **Figure 1**. Inclusion criteria: (1) malignant tumors diagnosed pathologically; (2) surgical treatment and adjuvant radiotherapy; (3) age 18–80 years old; (4) patients or family members able to use a smartphone. (5) age 18–80 years old; (6) patients or family members were able to use smartphones. Exclusion criteria: (1) with severe cardiac insufficiency; (2) with mental illness or cognitive impairment; (3) with language communication disorder. This study was approved by the Ethics Committee of the hospital. All application subjects signed an informed consent form before enrollment. The method of pathological staging of tumors was according to the TNM staging system. The pathological staging of tumors was

performed by combining the patient's TNM staging parameters—the status of the primary tumor (T), lymph nodes (N), and distant metastases (M)—to form overall stages such as I, II, III, and IV.

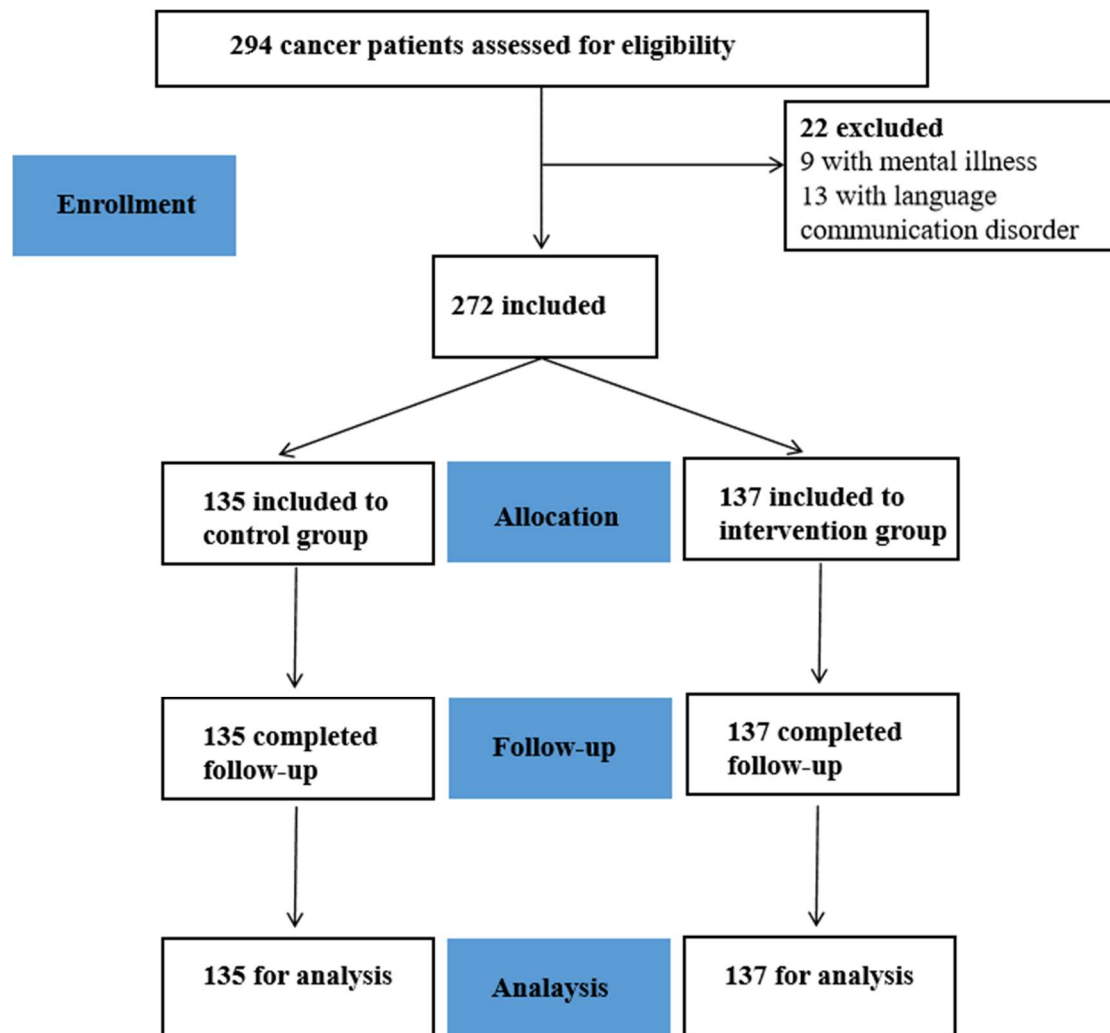


Figure 1. Study flow diagram.

2.3. Sample size calculation

PASS 11 software was used for sample size calculation with $\alpha = 0.05$ and $1-\beta = 0.9$. Considering that the completion rate of previous treatment was $> 60\%$ in the oncology department of our hospital, the sample size was calculated to be 117 cases. Considering a 20% decrease in sample size, the number of cases in each group was determined to be 147, for a total of 294 cases in the two groups.

2.4. Intervention

The control group adopted conventional cancer management. Patients with positive cancer screening in our hospital were diagnosed by experts themselves and then went to the department for pathological puncture, waiting for pathological results. If the pathology was positive, they would go to the oncology clinic by themselves and issue a medical order for hospitalization. After the patient was admitted to the hospital, offline multidisciplinary consultation was conducted to determine the diagnosis and

treatment plan. In the course of treatment or chemotherapy, health education, close observation of disease changes, and psychological and dietary care were given. Health education manuals were given to patients before discharge, and telephone follow-up was conducted at 1, 3, and 6 months after discharge to inquire about the physical condition of patients and give corresponding guidance.

The intervention group adopted the whole-course management, that is, the whole-course management of ‘screening-diagnosis-treatment-rehabilitation’ with the app as the carrier, including:

(1) The risk level of patients was divided by the tumor risk assessment scale in the app. Patients in the high-risk group were admitted to the hospital for accurate diagnosis and comprehensive treatment.

(2) After diagnosis and enrollment, the big data classified and enrolled patients according to the pathological examination results and treatment plan, and the case manager set up a health file for the enrolled patients, including pathological diagnosis at admission, MDT consultation, and initial treatment plan.

(3) After the patient was admitted to the hospital, based on the data center, the individualized management plan was formulated together with the responsible doctors, responsible nurses, and the patient himself, which ensured the normal communication between doctors and patients and the patient’s understanding of the disease process schedule.

(4) Nursing staff carried out nursing according to routine procedures and guided patients or their families to use the small procedures correctly to ensure the normal follow-up after diagnosis.

(5) After discharge, patients understood the disease knowledge map through the intelligent assistant function, and their diet was standardized according to dietary recommendations after discharge. In emergencies outside the management plan, patients could also consult online with a case manager, who would relay needs to clinicians and provide professional advice.

(6) According to the assessment of the condition, the time of follow-up consultation and return visit was updated in time so that the patient’s recovery was followed up properly and the patient’s health record was improved.

2.5. Outcomes

(1) Time to cancer diagnosis. The waiting times for puncture, pathology, admission, and screening were recorded.

(2) Clinical outcome. Clinical outcome was divided into four parts: complete remission, partial remission, stable disease, and progressive disease. Complete remission was defined as the disappearance of the patient’s symptoms and lesions and maintained for more than 1 month. Partial remission was defined as the reduction of symptoms and signs and the regression of lesions by more than 50% and maintained for more than 1 month. Stable disease was defined as the non-improvement of symptoms and signs and the regression of lesions by 25% to 50%. Progressive disease was defined as the improvement of symptoms and signs and the regression of lesions by < 25% or worsening. Objective remission rate = complete remission rate + partial remission rate.

(3) The average length of hospital stay and medical costs were recorded.

(4) Patient compliance. The medication adherence and adherence to rehabilitation training were compared at 1 month, 3 months, and 6 months after discharge. The case manager evaluated the patients by telephone using the medication adherence scale, and the patients filled in the scale according to their subjective feelings about medication or rehabilitation training. The scores of the five scales were 0, 0.25, 0.5, 0.75, and 1, respectively. The score was 8 points, with <6 as poor compliance, 6–7 as moderate compliance, and 8 as good compliance. The Cronbach's α coefficient of the scale was 0.960.

(5) Adverse effects. All adverse reactions were categorized using the Common Terminology Criteria for Adverse Events (CTCAE) version 5.0 [15]. The side effects during treatment, such as radiation dermatitis and radiation pneumonia caused by chemotherapy and radiotherapy, anticancer drug-induced bone marrow suppression, liver function damage and gastrointestinal damage, and postoperative lymphedema and subcutaneous effusion of the affected limb, were recorded.

(6) Negative emotions. The Self-rating Anxiety Scale (SAS) and Self-rating Depression Scale (SDS) were completed at admission, discharge, and 6 months after discharge. The SAS and SDS were used to evaluate the anxiety and depression levels of patients, respectively. The higher the score, the more severe the level of anxiety and depression.

(7) Quality of life: The EORTC QLQ-C30 scale was used to measure the quality of life of patients 6 months after discharge. The scale included five dimensions: physiological, emotional, cognitive, social and role, and the scores were proportional to the quality of life.

2.6. Statistical analysis

SPSS 20.0 statistical software was employed for analyzing the data. The counting data were exhibited as numbers and n (%), and the χ^2 test was applied for comparison. The measured data were expressed as mean $\pm$ SD, and all normally distributed continuous data were analyzed using Student's t test, while non-parametric data were analyzed using the Mann-Whitney U test. $P < 0.05$ was considered a statistically significant difference.

3. Results

3.1. Baseline information of patients

There was no significant difference in baseline data such as age, gender, marriage status, place of residence, underlying disease, pathological stage, pathological types of tumors, and treatment between the two groups ($P > 0.05$, **Table 1**).

3.2. Evaluation of the time of cancer diagnosis

As shown in **Table 2**, the time of cancer diagnosis was divided into three parts: waiting time for puncture, waiting time for pathology, and waiting time for admission. Except for the waiting time for pathology, the time spent on cancer diagnosis in the intervention group was less than that in the control group ($P < 0.05$).

Table 1. Baseline characteristics of 272 tumor patients (mean ($\pm$ SD)) or *n* (%).

Parameter		Control	Intervention	χ^2/t	<i>P</i>
Number		135	137		
Age (years)		59.35 $\pm$ 9.89	57.34 $\pm$ 9.12	1.743	0.083
Gender, <i>n</i> (%)	Male	65 (48.15)	74 (54.01)	0.937	0.333
	Female	70 (51.85)	63 (45.99)		
Marriage status, <i>n</i> (%)	Unmarried	15 (11.11)	15 (10.95)	2.667	0.444
	Married	110 (81.48)	104 (75.91)		
	Divorced	4 (2.96)	9 (6.57)		
	Widowed	6 (4.44)	9 (6.57)		
Educational level, <i>n</i> (%)	Middle school and below	62 (45.93)	56 (40.88)	0.871	0.647
	High school	57 (42.22)	61 (44.53)		
	College and above	16 (11.85)	20 (14.60)		
Place of residence, <i>n</i> (%)	Town	56 (41.48)	66 (48.18)	1.232	0.267
	Village	79 (58.51)	71 (51.83)		
Underlying disease, <i>n</i> (%)	Hypertensive	22 (16.29)	25 (18.25)	0.446	0.800
	Diabetes	18 (13.33)	21 (15.33)		
	Others	6 (4.44)	10 (7.30)		
Pathological stage, <i>n</i> (%)	I	82 (60.74)	90 (65.69)	2.067	0.356
	II	45 (33.33)	34 (24.82)		
	III	11 (8.15)	13 (9.49)		
Pathological types of tumors, <i>n</i> (%)	Lung cancer	32 (23.70)	34 (24.81)	0.314	0.957
	Breast cancer	33 (24.44)	36 (26.28)		
	Colorectal cancer	34 (25.19)	31 (22.63)		
	Prostate cancer	36 (26.67)	36 (26.28)		
Treatment, <i>n</i> (%)	Surgical	33 (24.44)	37 (27.01)	2.427	0.489
	Radiotherapy	19 (14.07)	15 (10.95)		
	Surgical + radiotherapy	66 (48.89)	74 (54.01)		
	Others	17 (12.59)	11 (8.03)		

Table 2. Evaluation of the time of cancer diagnosis in both groups [d, M (P25, P75)].

Groups	Puncture Waiting Time	Pathology waiting time	Waiting time for admission	Total time of admission
Control (<i>n</i> = 135)	2 (1, 4)	2 (1, 3)	7 (3, 12)	11 (7, 15)
Intervention (<i>n</i> = 137)	0 (0, 1)	2 (1, 3)	3 (1, 7)	6 (4, 9)
<i>t</i>	2.521	1	3.873	2.976
<i>P</i>	0.027	0.337	0.002	0.012

3.3. Assessment of patients' clinical outcomes

Calculated from the results in **Figure 2**, the objective response rate of the intervention group (45.26%) was higher than that of the control group (38.52%), but the difference was not statistically significant ($P > 0.05$).

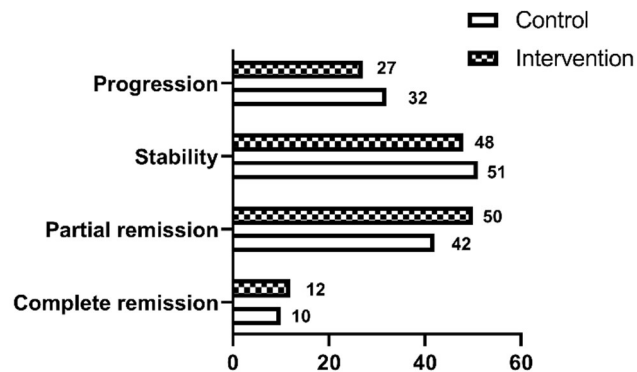


Figure 2. Assessment of patients' clinical outcome n (%).

3.4. Comparison of average length of hospital stay and medical costs

As shown in **Figure 3**, the length of hospital stay in the intervention group was 15.60 ± 3.47 days and the cost of hospitalization was $24,434.75 \pm 4721.60$ yuan, while the length of hospital stay in the control group was 16.61 ± 3.96 days and the cost of hospitalization was $25,795.96 \pm 5049.23$ yuan. Compared with the control group, the hospitalization time of the intervention group was shorter, and the medical expenses were lower ($P < 0.05$).

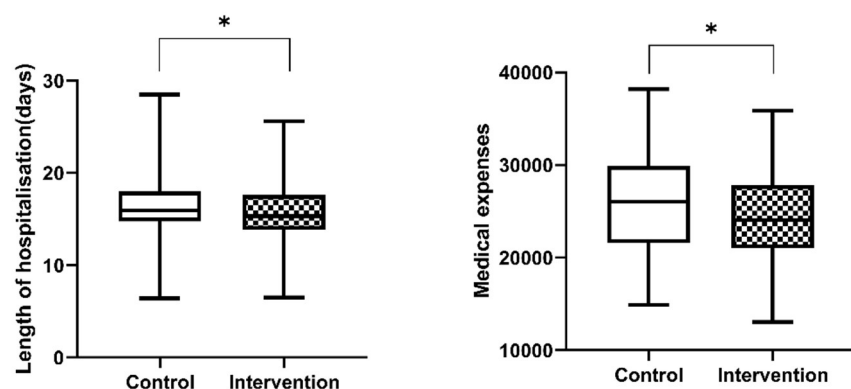


Figure 3. Statistics on the length of hospitalization and medical costs of the two groups of patients.

Notes: * $P < 0.05$.

3.5. Assessment of patient adherence

As shown in **Figure 4**, the intervention group had better medication adherence and rehabilitation adherence at 6 months of discharge compared to the control group ($P < 0.05$). In terms of medication adherence, the control group had poor adherence at 3 months after discharge, while the intervention group had poor adherence at 6 months after discharge. In terms of adherence to rehabilitation, the control group had poor

adherence one month after discharge, while the intervention group had poor adherence three months after discharge.

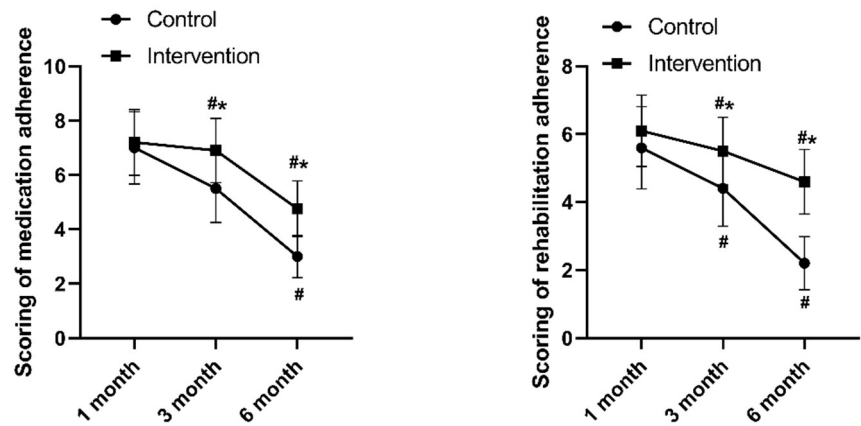


Figure 4. Adherence assessment at 1 month, 3 months, and 6 months after discharge in both groups.

Notes: # $P < 0.05$, vs 1 month after discharge; * $P < 0.05$, vs control group.

3.6. Assessment of post-treatment side effects

After treatment, the adverse reactions in the intervention group were less than those in the control group, among which the differences in radiation dermatitis, lymphedema, bone marrow suppression, liver function damage, and gastrointestinal damage were statistically significant (Table 3).

Table 3 Comparison of treatment-related side effects between the two groups of patients n (%).

Groups	Radiological dermatitis				Radiological pneumonia				Lymphoedema on the affected side	Subcutaneous fluid collection			
	I	II	III	IV	I	II	III	IV		I	II	III	IV
Control ($n = 135$)	10 (7.41)	6 (4.44)	3 (2.22)	1 (0.74)	6 (4.44)	2 (1.48)	1 (0.74)	0 (0.00)	16 (11.85)			12 (8.89)	
Intervention ($n = 137$)	6 (4.38)	2 (1.46)	1 (0.73)	1 (0.73)	2 (1.46)	1 (0.73)	0 (0.00)	0 (0.00)	7 (5.11)			5 (3.65)	
χ^2	3.914				3.232				3.993				
P	0048				0.072				0.046				
Groups	Myelosuppression				Hepatic impairment				Gastrointestinal damage				
	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Control ($n = 135$)	15 (11.11)	9 (6.67)	8 (5.93)	5 (3.70)	10 (7.41)	8 (5.93)	2 (1.48)	2 (1.48)	17 (12.59)	11 (8.15)	7 (5.19)	5 (3.70)	
Intervention ($n = 137$)	7 (5.11)	4 (2.92)	2 (1.46)	3 (2.19)	2 (1.46)	2 (1.46)	2 (1.46)	1 (0.73)	6 (4.38)	4 (2.92)	3 (2.19)	1 (0.73)	
χ^2	20.45				8.934				16.1				
P	<0.001				0.003				<0.001				

3.7. Assessment of anxiety and depression

Compared with before intervention, anxiety and depression were significantly improved after intervention and 6 months after discharge in both groups ($P < 0.05$).

Among them, anxiety and depression scores were lower in the intervention group than in the control group after intervention and at 6 months after discharge ($P < 0.05$). At the sixth month after treatment, the SAS score in the intervention group (46.92 ± 4.52) was in the normal range compared to the control group (50.23 ± 4.37). The SDS score of the intervention group (48.33 ± 4.05) was also in the normal range compared to the control group (52.11 ± 4.17) (Figure 5).

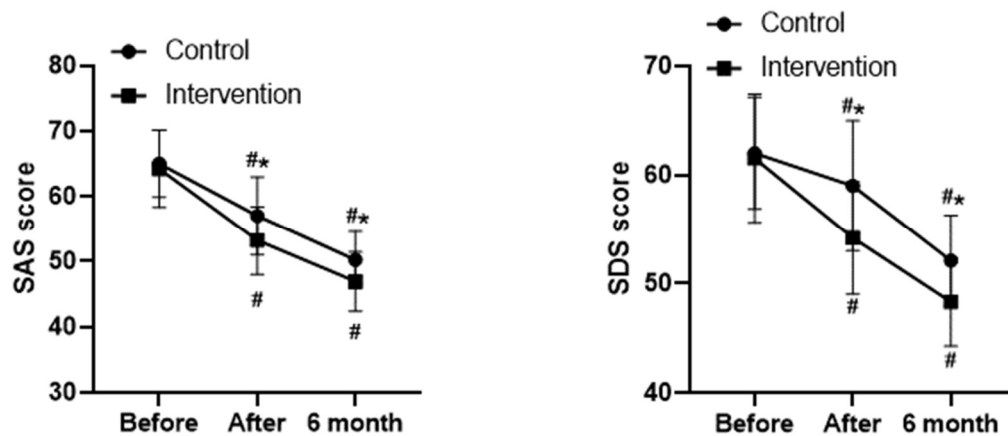


Figure 5. Assessment of depression and anxiety in both groups of patients.

Notes: # $P < 0.05$, vs before treatment; * $P < 0.05$, vs control group.

3.8. Assessment of quality of life

The EORTC QLQ-C30 score of the intervention group was better than that of the control group 6 months after discharge, and the difference was statistically significant ($P < 0.05$, Figure 6).

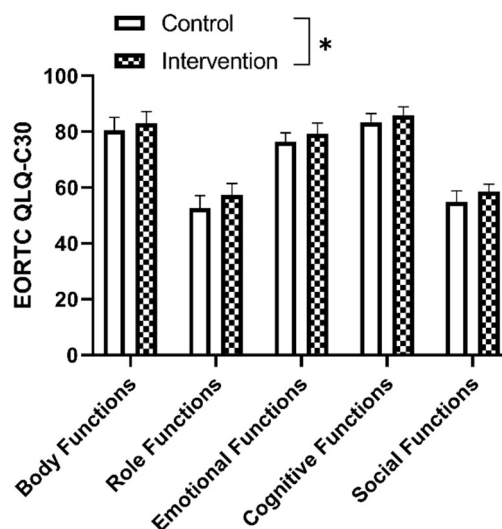


Figure 6. EORTC QLQ-C30 scale scores of patients in both groups.

Notes: * $P < 0.05$.

4. Discussion

4.1. The whole-course management model helps to improve the efficiency and reduce the cost of cancer patient care

Early diagnosis and treatment are the keys to improving patient survival and clinical outcomes [16]. The results of this study showed that the average waiting time from screening to hospitalization in the intervention group was significantly better than in the control group, which was due to the use of an information system for pre-diagnosis management of patients in this study. As a link between departments and personnel, the information system realized the sharing of patient information across multiple departments, which was the guarantee of effective management [17]. This study formed a hospital screening and intervention mechanism of multidisciplinary collaboration, which changed the shortcomings such as long appointment times and delayed treatment in the process of screening-puncture-pathological diagnosis-admission, and to some extent made up for the shortcomings of the hospital's opportunistic cancer screening system. High-risk groups were screened according to the cancer risk self-assessment system, and the whole process management information system could quickly determine the high-risk groups for intervention.

Studies have shown that early treatment support can shorten the length of hospital stay and cost and reduce the burden on patients [18]. In this study, we also counted the length of hospitalization and the cost required by the patients who received treatment, and the results showed that the average length of hospital stay and cost of the patients in the intervention group were lower than those in the control group ($P < 0.05$). The reasons may be as follows: (1) Based on the cancer risk self-assessment system, high-risk groups were screened from community screening, and based on these groups, the precise decision of whether to include them in the whole course of cancer management could achieve the purpose of early and extensive cancer screening and avoid the late diagnosis, which was difficult or impossible to treat. (2) For diagnosis, follow-up appointments and review items could be made for patients through the oncology whole process app, which could effectively complete follow-up appointments and chemotherapy treatment, thereby shortening the length of hospital stay. (3) Patients could be discharged after completing the current chemotherapy treatment if they did not have any special discomfort, which can reduce the phenomenon of "bed pressure", and patients could be discharged with fewer instances of bed turnover pressure. (4) Patients could undergo regular blood tests in local hospitals after discharge, and upload the test results through the small program, so that the doctor in charge of the bed could understand the test results of patients through the small program platform, and give targeted guidance, so as to ensure the safety of patients after discharge.

4.2. Whole-course management model helps to reduce and improve the quality of patients' disease management

The whole-course service model constantly breaks the barriers of the traditional medical care service model, re-establishes the clinical care service path, and connects health prevention, early disease screening, admission preparation service, hospital MDT multi-specialty diagnosis and treatment, hospice care, and other life-cycle-

related service links to form a complete service chain. At the same time, the whole service mode combines the case management information system with internet + nursing service, realizes the accessibility of continuous nursing after discharge of patients, and promotes the further development of “patient-centered” modern medical and nursing service mode [13]. The practice results show that the whole-course service model can improve the timely treatment rate of patients with multiple and single diseases, improve the quality of treatment and disease management level of patients [19].

Postoperative cancer rehabilitation is a long-term process, and the knowledge education received by patients in the hospital is gradually weakened or forgotten. Coupled with the lack of supervision and guidance of home rehabilitation, the compliance of patients to drug therapy and rehabilitation is decreased. In this study, the medication adherence and rehabilitation adherence of the intervention group were higher than those of the control group at 1, 3, and 6 months after discharge ($P < 0.05$). It has been reported that the lack of knowledge about professional knowledge is the main reason for poor adherence [20]. In this study, whole-course management was applied to cancer patients during hospitalization and after discharge. During hospitalization, multidisciplinary intervention was used to accurately assess the status and needs of patients, formulate comprehensive treatment plans, and guide individuals to consciously maintain behavior change through continuous information input. After discharge, the patient’s recovery was followed up by telephone, and the patient’s questions were answered in a timely manner. On the Internet, relevant knowledge was regularly pushed through the app to consolidate patients’ rehabilitation knowledge and improve patients’ rehabilitation awareness. Online consultation and cooperative intervention not only ensure the consistency and coherence of diagnosis and treatment but also promote the compliance of patients with rehabilitation.

Side effects are common during cancer treatment, which is due to the disruption of normal cell and immune system function by chemotherapy, radiotherapy, and some anticancer drugs [21]. Prospective prediction of possible side effects and interventions for patients with different tumors on a whole oncology management platform reduced the side effects and adverse reactions during the treatment of patients.

4.3. Whole-patient management model helps improve prognosis for cancer patients

Studies have shown that meeting the care needs of cancer patients not only promotes patient participation in decision-making and reduces anxiety and depression but also improves the quality of life of patients and establishes a good doctor-patient relationship [22]. After the pathological diagnosis was made, the case manager contacted the patient to explain the need for timely treatment and to introduce the hospital team’s understanding of the disease and treatment results to increase the patient’s confidence in treatment. Patients could raise questions and concerns in time during the consultation, and medical staff could soothe patients’ negative emotions. Studies have shown that health education and nursing carried out by medical staff in a long intervention period can help to reduce patients’ self-conscious symptoms and negative emotions and increase patients’ good sense of health [23]. In this study, the

whole process management team began to communicate with patients in the pre-hospital stage to establish a good doctor-patient relationship. In the management process, the management plan was constantly revised according to the needs and rehabilitation of patients. After discharge, the team maintained communication with patients for a long time through online and offline forms, which strengthened the dependence and motivation of patients on rehabilitation and improved the quality of life of patients. This was responsible for the significant improvement in SDS, SAS scores, and quality of life 6 months after discharge from the hospital in the intervention group.

4.4. Limitations

This study has some limitations that need to be evaluated. First, it was a quasi-experimental pre- and post-study design that lacked randomization. Therefore, our study has a potential selection bias in practice that is affected by time or treatment changes. Second, as a single-center study, external validity needs to be confirmed.

5. Conclusion

The whole-course management model is a high-quality, low-cost and high-efficiency health care model, which can shorten the average hospitalization days and hospitalization costs of cancer patients, improve the diagnosis and treatment efficiency and compliance of patients, and improve the side effects and quality of life, which is in line with the trend of the new era of health management and services and allows patients to truly feel the humanized, intelligent and comprehensive medical services brought by ‘Internet + Healthcare’. However, the association and sharing between the whole-course management system and the electronic medical record system are not perfect and the process is complicated. In the future, we will focus on improving the whole process management service process and smoothing the two-way referral channel. In addition, this study is a single-center study with small sample size and limited time. If time and economy permit, the sample size can be expanded, the evaluation index and management system can be optimized, and a standard database and knowledge base system can be formed.

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