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Application of Medical Consortium Service in Rural Areas for PICC Placement Among Oncology Patients: Evidence from a Cohort Study

Xiaomei Hu, Fengming Zou, Wendan Zheng, Kunyan Yue, Jing Zhou, Xiao Liu*, Xiaokai Yan*, Min Wu, Jiangqin Xiong, Anyan Zhang, Xi Chen, Wenbi Huang, Anxian Huang, Guoping He and Xiaojing Tian*

Zunyi Medical University, China

Abstract

Aim: To compare the effectiveness, safety, and economic benefits of medical consortium service with traditional health service in rural areas for PICC placement among oncology patients.

Design: Prospective cohort study.

Methods: Patients who were diagnosed with cancer and with a PICC placed were recruited from Affiliated Cancer Hospital of Zunyi Medical University, China. Data were collected between March 2019 and August 2022, with long-term follow-up until removal. Multivariable cox regression models were performed for complications between two groups.

Result: A total of 653 participants in the analysis. The exposure group (n=276) experienced fewer catheter-related complications and patient-related complications, such as catheter dislodgement, catheter obstruction, venous thrombosis, puncture site infection, allergic dermatitis, and tension blister, compared to the control group (n=377). The average cost and time used for PICC maintenance were much less in the exposure group compared to the control group.

Conclusion: The application of a medical consortium service in rural areas for PICC placement among oncology patients demonstrated promising results in this prospective cohort study. The intervention was effective in reducing complications, enhancing patients' health-related behaviors and attitudes, and improving patients' quality of life. Further research is needed to explore the long-term benefits and cost-effectiveness of this approach, as well as its applicability in different healthcare settings.

Keywords: Medical consortium service; Rural areas; PICC placement; Cohort study

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Correspondence:

Jing Zhou, Zunyi Medical University, Intersection of Xinlong Avenue and Xinpu Avenue, Honghuagang District, Zunyi 563006, Guizhou, China

Xiao Liu, Zunyi Medical University, Intersection of Xinlong Avenue and Xinpu Avenue, Honghuagang District, Zunyi 563006, Guizhou, China

Xiaokai Yan, Zunyi Medical University, Intersection of Xinlong Avenue and Xinpu Avenue, Honghuagang District, Zunyi 563006, Guizhou, China

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Introduction

Cancer is a leading cause of death worldwide. In the recent years, with the social and economic development and lifestyle change, cancer burden is increasing. It is estimated that the number of new cancer cases reached 19.3 million globally, and nearly 10 million people died from cancer in 2020 [1]. Among them, China accounted for 24% of newly diagnosed cases and 30% of the cancer-related deaths worldwide in 2020 [2].

Chemotherapy is still one of the main treatments for malignant tumors [3]. Safe access to chemotherapy delivery and repeated blood sampling in oncology patients is vital in clinical practice. The Peripherally Inserted Central Catheters (PICCs) and Totally Implanted Vascular Access Devices (TIVADs) are regarded as common methods for chemotherapy delivery [4]. Although TIVADs with lower infection rates, increased durability, better patient comfort and quality of life, PICCs is widely used in rural areas. The preference for PICCs over TIVADs in rural areas may be attributable to several factors. Firstly, the initial cost associated with TIVADs tends to be higher compared to PICCs, which could be a decisive factor in economically constrained rural environments. Secondly, the TIVAD insertion procedure requires a sterile surgical setting, general anesthesia, and healthcare professionals equipped with surgical expertise, resources that might not be easily accessible in rural areas. In contrast, PICCs can be inserted by specifically trained nurses, making them a more practical solution in such circumstances. Lastly, from a patient perspective, PICCs may be favored due to their less invasive nature as compared to TIVADs, and because their removal does not necessitate

a surgical procedure. However, after long-term placement of PICC will lead to complications, such as an increased risk of infection, thrombosis, and phlebitis [5]. Such complications may be associated with increased morbidity and mortality [5,6]. Some studies found that effective and individualized management of PICC placement would greatly reduce the incidence of complications [7,8].

Guizhou Province in China has steep and hilly topography covering 92.5% of the land area. The death of chronic diseases in the province has accounted for 86.6% of the total death, among which the incidence rate of cancer is no less than 169.07/100,000 and the mortality rate is 93.02/100,000. Patients living in mountainous areas suffer from inconvenient transportation and experience economic difficulties. Patients with chronic diseases such as tumor and leukemia need long-term intravenous infusion and standardized chemotherapy. Therefore, PICC catheterization is the best choice for their long-term intravenous infusion, but PICC needs regular maintenance until removal. By 2017, it was estimated there were only 26 PICC placement and maintenance sites in the province, but most of them were concentrated in hospitals located in the urban or central of the city. Thus, discharged patients in the rural has great difficulties for PICC maintenance. The cost and time of transportation are much higher than the cost and time of maintenance, which makes many patients reluctant to be placed with PICC. And even if a small number of patients with PICC placed, the lack of maintenance for up to one month also poses a great safety hazard. Addressing maintenance problem of PICC becomes an urgent problem.

A medical consortium, usually consisting of tertiary hospitals, secondary hospitals, and community and village health centers, is a specific vertical integration model of regional medical resources, and has unified various medical resources to integration, including finance, technology and management in a region [9,10]. Patients in the rural can receive homogeneous maintenance management within the medical association, solving the uneven allocation of medical resources between urban and rural areas, and providing continuous and good quality services [9,11,12]. However, information regarding application of medical consortium service in rural areas for PICC placement among oncology patients is limited. Therefore, this paper aims to compare the effectiveness, safety, and economic benefits of medical consortium service with traditional health service.

Materials and Methods

Participants

Patients who were diagnosed with cancer and with a PICC placed were recruited from Affiliated Cancer Hospital of Zunyi Medical University in Zunyi City, Guizhou Province, China. Data were collected between March 2019 and August 2022, with long-term follow-up until removal. Inclusion criteria were as follows: (1) adults aged 18 years or older, (2) patients living in rural areas with more than five years; (3) Patients with new PICC placed and were extubated in our hospital after the end of treatment; (4) able to complete the questionnaire independently, and (4) able to receive regular catheter maintenance and maintenance was performed in medical consortium or local health center in Zunyi city. Exclusion criteria were as follows: (1) Patients with uncontrolled diabetes and other severe metabolic disorders; (2) patients with severe heart, lung, kidney dysfunction or mental disorders; (3) Extremely thin patients with a BMI ≤ 15, and (4) life expectance was less than 1 year.

The study complied with the STROBE guidelines for the reporting of observational studies. Study procedures were reviewed and approved by the institutional review board of the Second Affiliated Hospital of Zunyi Medical University (Ethical review approval number: KXLL-2022-046), and all participants or their legal proxy provided informed consent before study participation.

Design

Our study was a prospective cohort study. Two divergent groups were conceived, categorized by the individuals' choice of medical services: The exposed group (Medical consortium service) and the control group (Traditional medical health service). The exposure group received health education training and medical consortium service, while the control group experienced health education training and traditional medical health service.

Demographic factors (age, sex, body mass index, and marital status), socioeconomic status (education level, years of work experience, and average annual household income), lifestyle factors (smoking status, alcohol assumption, physical activity, and diet), history of disease (hypertension, diabetes, and hyperlipidemia), and cancer-related and catheter placement related factors were collected at baseline.

A total of 753 individuals were eligible to participate in the study. Among them, 726 granted consent, achieving a response rate of 96.4%. Unfortunately, of the initial 726 consenting individuals, 73 patients declined to continue during the follow-up. Ultimately, 653 patients were meticulously selected and included in the final analysis. The selection process of included participants was presented in flowchart (Figure 1).

Procedure

Health education training: All participants received Health Education Training (HET). HET was designed by a team of healthcare professionals consisting of clinicians, nurses, pharmacists and psychologists. HET started with a face-to-face meeting before patients discharged between the instructor, participant, and his/her caregivers, which focused on the need for PICC care, management and maintenance, and recognizing potential complications. Subsequently, to facilitate home learning, we gave each participant a specifically designed device, which contained videos and books.

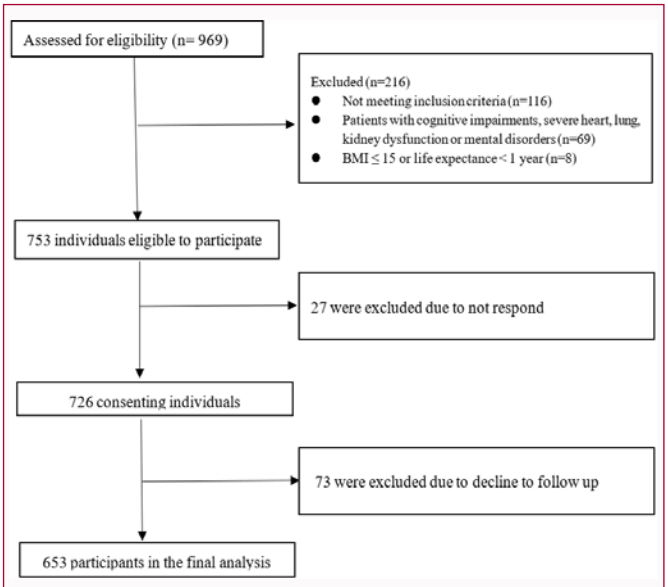

Figure 1: Flowchart of include participants.

Videos topics included being a smart patient (3 videos), drinking and smoking (2 videos), physical activity (2 videos), nutrition (2 videos), sleep (1 video); physical pain (2 videos), and keeping good mental health (2 videos). The Book summarized all the key points of videos and listed relevant articles written by experts.

Medical consortium service: Our hospital was one of the affiliated hospitals of Zunyi Medical University, which was the best hospital group in Zunyi City. We took the lead in constructing the medical consortium in the rural area, which included tertiary hospitals, secondary hospitals, and community and village health centers. The core group was responsible for the operation, coordination and development of the medical consortium, and its members included 1 director of the nursing department, 1 director of the interventional department, 1 director of the oncology department, 5 chief nurses, 10 nurses with five-year experience in PICC intubation in our hospital and 30 nurses selected from different institutions.

Nurses recommended by other institutions also participated in standardized training, which were theory teaching such as vascular anatomy, introduction of PICC, maintenance of PICC, common complications of PICC, etc., and skills training such as blind PICC penetration, ultrasonic placement, PICC maintenance training, cardiopulmonary resuscitation, etc. Clinical practice was one-on-one guidance and a certificate would be issued to those who pass all the tests. Regular evaluation and assessments were conducted by biweekly follow-up visits.

Additionally, a telemedicine platform was developed, enabling remote consultations, multidisciplinary case discussions, and monitoring of patient progress. The platform informed the discharged patients the day before PICC maintenance, and special requirements and precautions for PICC maintenance would be distributed to them. Patients' related information was updated timely and shared with targeted nurses.

Traditional medical health service: Traditional medical health services referred to the conventional healthcare delivery system, where patients received standardized care from local healthcare providers without the support of a medical consortium or advanced telemedicine technologies.

Measures

The measures of primary outcome were complications of PICC during this period, which included catheter dislodgement, catheter obstruction, catheter displacement, catheter rupture, unplanned removal, puncture site oozing, phlebitis, venous thrombosis, puncture site infection, allergic dermatitis, tension blister, and catheter-related infection. The measures of secondary outcomes were average costs and time spent on PICC maintenance, which included registration fee, maintenance fee, transportation fee, round trip time and visit time.

To assess the health-promoting behaviors of the participants, Health Promotion Lifestyle Profile II (HPLP-II) was performed, which has been developed and widely utilized [13-15]. HPLP-II measure consisted of fifty-two items, based on six dimensions, namely spiritual growth (9 items), health responsibility (9 items), physical activity (8 items), nutrition (9 items), interpersonal relations (9 items) and stress management (8 items), with a four-point Likert scale for each item, ranging from 1 (never) - 4 (routinely). Validity and reliability have been measured with good performance in the previous studies and among Chinese population [15,16].

Quality of life was examined by using European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ-C30), which included five functional scales (physical, role, cognitive, emotional, and social functioning), three symptom scales (fatigue, pain, and nausea/vomiting), a global health status scale, and five single items (constipation, diarrhea, insomnia, dyspnea, appetite Loss) [17]. The indicator of financial difficulties was not used in this study. Scores for each scale and single-item measures were averaged and transformed linearly to a score ranging from 0 to 100. A high score for functional scales and for Global Health Status represent better functioning ability, whereas a high score for symptom scales and single items represents significant symptomatology [18]. The questionnaire has been validated and was one of the most widely used cancer-specific instruments [19-23].

Data analysis

EpiData 3.02 software was used to establish the database. Data were analyzed using the SPSS software program, version 22.0 (Statistical Package for the Social Sciences, Chicago, Illinois). Continuous variables were presented as mean ± standard deviation, and categorical variables were presented as number (percentage). To compare characteristics between two groups, T-test was conducted for continuous data and Chi-square test was used for categorical data. The difference was considered statistically significant at P value <0.05. To calculate the Hazard Ratios (HRs) and 95% Confidence Interval (95% CI) for complications between two groups, multivariable cox regression models were performed. Person-years at risk were calculated from the date of recruitment until the diagnosis of catheter-related complications and patient-related complications, the date of lose to follow-up, the date of death, or August 31st, 2022, whichever came first.

Results

Basic characteristics of included patients were presented in Table 1. The average age of exposure group and control group were 50.7 ± 12.5 years and 50.3 ± 12.1 years, respectively. Female accounted for 53.1% in total sample. The exposure group had a higher proportion of married individuals (73.2% *vs.* 63.7%, P=0.010), but lower levels of current smokers (10.1% *vs.* 16.2%, P=0.015) and drinkers (5.8% *vs.* 10.9%, P<0.001). The exposure group consumed fewer fruits (4.1 ± 2.0 *vs.* 4.6 ± 2.3 times/week, P=0.004) and more vegetables (3.7 ± 2.2 *vs.* 3.1 ± 1.8 times/week, P<0.001), and had less frequent processed meat intake (1.2 ± 0.7 *vs.* 1.3 ± 0.5 times/week, P=0.034). The exposure group had a higher average annual household income and higher education background (P<0.05), while the control group had a higher prevalence of hyperlipidemia (17.8% *vs.* 9.8%, P=0.004). No significant differences were observed in age, BMI, physical activity, work experience, and histories of hypertension and diabetes.

Table 2 compared the characteristics of cancer and catheter placement between two groups. No significant differences were observed in cancer type (P=0.387), cancer staging (P=0.232), duration of cancer (P=0.138), history of thrombosis (P=0.313), catheter placement site (P=0.334), or vein used for catheter placement (P=0.833).

Comparisons of complications between two groups by using two multivariable cox regression models were shown in Table 3. It was discerned that in both Model 1 and Model 2, specific complications such as mild catheter dislodgement (Model 2: HR: 0.83, P=0.016), partial catheter obstruction (Model 2: HR: 0.76, P=0.008), Grade

Table 1: Basic characteristics of included patients.

	Exposure group (n=276)	Control group (n=377)	P-value
Age (years)			0.683
18-39	41 (14.9%)	51 (13.5%)	
40-59	162 (58.7%)	234 (62.1%)	
≥ 60	73 (26.4%)	92 (24.4%)	
Gender			<0.001
Male	106 (38.4%)	200 (53.1%)	
Female	170 (61.6%)	177 (46.9%)	
Body mass index (kg/m²)	23.5 ± 4.5	22.9 ± 4.1	0.077
Marital status			0.01
married	202 (73.2%)	240 (63.7%)	
unmarried/divorced	74 (26.8%)	137 (36.3%)	
Smoking status			0.015
current	28 (10.1%)	61 (16.2%)	
previous	166 (60.1%)	234 (62.1%)	
never	82 (29.7%)	82 (21.8%)	
Drinking status			<0.001
current	16 (5.8%)	41 (10.9%)	
previous	101 (36.6%)	260 (69.0%)	
never	159 (57.6%)	76 (20.2%)	
[a]Frequency of physical activity			0.189
<3 times/week	124 (44.9%)	150 (39.8%)	
≥ 3 times/week	152 (55.1%)	227 (60.2%)	
Weekly red meat consumption (times/week)	3.5 ± 2.3	3.7 ± 2.2	0.261
Weekly processed meat consumption (times/week)	1.2 ± 0.7	1.3 ± 0.5	0.034
Weekly fruit consumption (times/week)	4.1 ± 2.0	4.6 ± 2.3	0.004
Weekly vegetable consumption (times/week)	3.7 ± 2.2	3.1 ± 1.8	<0.001
Weekly fish/poultry consumption (times/week)	3.6 ± 2.4	3.4 ± 2.1	0.258
Education level			<0.001
primary school and below	45 (16.3%)	188 (49.9%)	
secondary school or vocational school	198 (71.7%)	163 (43.2%)	
college, university and above	33 (12.0%)	26 (6.9%)	
Years of work experience			0.92
≤ 10 years	138 (50.0%)	187 (49.6%)	
>10 years	138 (50.0%)	190 (50.4%)	
Average household income (RMB, yuan)			0.009
≤ 40000	166 (60.1%)	264 (70.0%)	
>40000	110 (39.9%)	113 (30.0%)	
History of hypertension			0.338
yes	75 (27.2%)	90 (23.9%)	
no	201 (72.8%)	287 (76.1%)	
History of diabetes			0.07
yes	21 (7.6%)	45 (11.9%)	
no	255 (92.4%)	332 (88.1%)	
History of hyperlipidemia			0.004
yes	27 (9.8%)	67 (17.8%)	
no	249 (90.2%)	310 (82.2%)	

Physical activity refers to activities that last for more than 30 min per session, elevate the heart rate, and involve exertion of the body, including walking, running, cycling, yoga, gym workouts, dancing, ball games, et al.

Table 2: Characteristics of cancer and catheter placement between two groups.

	Exposure group (n=276)	Control group (n=377)	P-value
Cancer type			0.387
Digestive system	88 (31.9%)	100 (26.5%)	
Respiratory system	28 (10.1%)	52 (13.8%)	
Hematopoietic system	38 (13.8%)	56 (14.9%)	
Gynecologic tumors	50 (18.1%)	81 (21.5%)	
Nasopharyngeal carcinoma	30 (10.9%)	32 (8.5%)	
Urinary system	22 (8.0%)	35 (9.3%)	
Others	20 (7.2%)	21 (5.6%)	
Cancer staging			0.232
Early stage	24 (8.7%)	45 (11.9%)	
Intermediate stage	183 (66.3%)	254 (67.4%)	
Advanced stage	69 (25.0%)	78 (20.7%)	
Duration of cancer (year)			0.138
< 1	164 (59.4%)	202 (53.6%)	
≥ 1	112 (40.6%)	175 (46.4%)	
History of thrombosis			0.313
Yes	7 (2.5%)	15 (4.0%)	
No	269 (97.5%)	362 (96.0%)	
Catheter placement site			0.334
Left arm	88 (31.9%)	107 (28.4%)	
Right arm	188 (68.1%)	270 (71.6%)	
Vein			0.833
Vena basilica vein	235 (85.1%)	315 (83.6%)	
Median elbow vein	35 (12.7%)	54 (14.3%)	
Cephalic vein	6 (2.2%)	8 (2.1%)	

I puncture site infection (Model 2: HR: 0.81, P=0.027), venous thrombosis (Model 2: HR: 0.83, P=0.020), mild allergic dermatitis (Model 2: HR: 0.80, P=0.035) and tension blister (Model 2: HR: 0.81, P=0.016) demonstrated significant reductions in risk in the exposure group, compared to the control group. However, other complications did not display substantial discrepancies between the groups across both models. Results about the average costs and time spent on PICC maintenance, as shown in Table 4. Our findings revealed that the exposure group had significantly lower average costs for registration (RMB 6.5 ± 2.5 *vs.* RMB 10.5 ± 2.5, P<0.001), maintenance (RMB 37.5 ± 5.8 *vs.* RMB 56.9 ± 7.5, P<0.001), and transportation (RMB 11.5 ± 2.6 *vs.* RMB 45.7 ± 5.8, P<0.001) compared to the control group. Furthermore, the exposure group also experienced a significantly shorter average time spent on round-trip travel (40.2 ± 10.4 min *vs.* 103.1 ± 20.6 min, P<0.001) and visit time (15.7 ± 5.4 min *vs.* 40.8 ± 12.7 min, P<0.001) compared to the control group.

Table 5 compared health-related behaviors and quality of life between the exposure group and the control group. The differences in the HPLP-II scores between the two groups before catheter placement were not statistically significant (P>0.05); however, the

Table 3: Adjusted hazard ratios and 95% confidence interval for complications between two groups (exposure group *vs.* control group).

	Model 1		Model 2	
	HR (95% CI)	P value	HR (95% CI)	P value
Catheter-related complications				
Catheter dislodgement				
Severe	0.85 (0.61-1.31)	0.53	0.91 (0.68-1.36)	0.434
Moderate	0.78 (0.59-1.11)	0.171	0.86 (0.67-1.17)	0.113
Mild	**0.73 (0.55-0.96)**	**0.028**	**0.83 (0.62-0.97)**	**0.016**
Catheter obstruction				
Complete	0.78 (0.33-1.33)	0.41	0.71 (0.27-1.28)	0.399
Partial	**0.81 (0.69-0.96)**	**0.015**	**0.76 (0.64-0.90)**	**0.008**
Catheter displacement	0.94 (0.81-1.09)	0.262	0.92 (0.83-1.06)	0.244
Catheter rupture	0.98 (0.67-1.38)	0.355	0.94 (0.64-1.31)	0.350
Unplanned removal	0.88 (0.59-1.43)	0.556	0.91 (0.61-1.41)	0.539
Patient-related complications				
Puncture site oozing				
Grade III	0.99 (0.28-3.57)	0.993	0.97 (0.33-3.31)	0.876
Grade II	0.81 (0.61-1.11)	0.159	0.86 (0.67-1.05)	0.091
Grade I	**0.77 (0.62-0.98)**	0.041	0.84 (0.62-1.01)	0.051
Phlebitis	0.89 (0.66-1.27)	0.222	0.94 (0.74-1.33)	0.257
Venous thrombosis	**0.82 (0.71-0.95)**	0.022	**0.83 (0.72-0.96)**	0.02
Puncture site infection				
Grade II	0.96 (0.71-1.45)	0.26	1.01 (0.77-1.47)	0.278
Grade I	**0.77 (0.65-0.91)**	**0.01**	**0.81 (0.71-0.94)**	**0.027**
Allergic dermatitis				
Severe	0.86 (0.70-1.12)	0.22	0.91 (0.77- 1.33)	0.231
Moderate	0.85 (0.73-1.29)	0.225	0.90 (0.81-1.40)	0.246
Mild	**0.77 (0.63-0.89)**	**0.033**	**0.80 (0.64-0.94)**	**0.035**
Tension blister	**0.83 (0.69-0.93)**	**0.021**	**0.81 (0.66-0.90)**	**0.016**
Catheter-related infection	0.77 (0.44-1.55)	0.32	0.81 (0.64-1.50)	0.307

Model 1 adjusted for age, sex, body mass index, marital status, education level, years of work experience, household income, smoking status, drinking status, physical activity, weekly red meat consumption, weekly processed meat consumption, weekly vegetable consumption, weekly fruit consumption, weekly fish/poultry consumption, and history of hypertension, diabetes, and hyperlipidemia.

Model 2 further adjusted for cancer staging, duration of cancer, vein and catheter placement site.

HPLP-II scores of the two groups increased after removal, and the differences were statistically significant between the two groups. There were statistical differences in all dimensions and the total score in the HPLP-II of the exposure group before catheter placement and after removal (P<0.05), while statistical differences occurred in spiritual growth, physical activity, nutrition, stress management and the total score of the control group before catheter placement and after removal. The differences in the EORTC QLQ-C30 scores between the two groups before catheter placement were not statistically significant (P>0.05); after removal, the EORTC QLQ-C30 scores of both groups improved, and the differences between the two groups were statistically significant in most measures, except for social functioning, pain, dyspnea, and diarrhea. There were statistical differences in all measures in the EORTC QLQ-C30 of the exposure group before catheter placement and after removal (P<0.05), while

Table 4: Comparison of average costs and time spent on PICC maintenance in two groups.

	Exposure group (n=276)	Control group (n=377)	P-value
Average cost (RMB)			
Registration Fee (RMB)	6.5 ± 2.5	10.5 ± 2.5	<0.001
Maintenance Fee (RMB)	37.5 ± 5.8	56.9 ± 7.5	<0.001
Transportation Fee (RMB)	11.5 ± 2.6	45.7 ± 5.8	<0.001
Average time spent (minute)			
Round Trip Time (minute)	40.2 ± 10.4	103.1 ± 20.6	<0.001
Visit Time (minute)	15.7 ± 5.4	40.8 ± 12.7	<0.001

statistical differences in most measures of the control group before catheter placement and after removal, except for cognitive functioning and constipation.

Discussion

This prospective cohort study was designed to assess the effectiveness and potential advantages of implementing a medical consortium service in rural areas for PICC placement among oncology patients. To the best of our knowledge, it was the first study to compare medical consortium service with traditional medical health service in rural areas. Our findings revealed that medical consortium service decreased complications of PICC, cost and time for PICC maintenance, improved patients' health-related behaviors and attitudes, and further enhanced quality of life.

The challenges faced by rural healthcare systems are well-documented and include limited access to specialized medical services, inadequate healthcare infrastructure, and a shortage of skilled healthcare professionals [24,25]. These factors contribute to disparities in healthcare outcomes between rural and urban populations [26]. The medical consortium service model has been proposed as a way to address these disparities by fostering collaboration between healthcare providers and leveraging the expertise and resources to improve rural healthcare outcomes [12].

Our study found a substantial reduction in PICC-related complications in the medical consortium service group compared to the control group. This can be attributed to several factors, including improved standardization of procedures and the exchange of knowledge and expertise between healthcare providers within the consortium, which was supported by greatly improvements of nurses' theoretical knowledge and competence skills [27]. Additionally, the increased use of advanced technologies and access to specialized training for rural healthcare professionals likely contributed to better PICC placement and management, thus reducing the risk of complications [28].

The average cost and time used for PICC maintenance were much less in the medical consortium service group compared to the control group, which may result in higher satisfaction in the medical consortium service group, and further improved quality of life. Enhanced quality of life can be explained by several factors. Firstly, the medical consortium service model enabled rural patients to receive specialized care closer to their homes, reducing the need for extensive travel to urban centers [29]. This not only reduced the financial burden on patients and their families but also minimized the disruption to their daily lives. Secondly, the availability of specialized

Table 5: Scales for health-related behaviors and attitudes and quality of life between two groups.

	Range	Before catheter placement			After removal			$P_{before-after}$ Value	
		Exposure group (n=276)	Control group (n=377)	P-value	Exposure group (n=276)	Control group (n=377)	P-value	Exposure group	Control group
HPLP-II									
Spiritual growth	9-36	13.4 ± 3.3	13.0 ± 3.9	0.168	19.1 ± 2.7	14.8 ± 3.1	<0.001	<0.001	<0.001
Health Responsibility	9-36	17.8 ± 4.6	18.5 ± 4.7	0.058	25.8 ± 2.1	19.1 ± 3.8	<0.001	<0.001	0.054
Physical Activity	8-32	16.8 ± 2.5	16.5 ± 2.4	0.122	27.6 ± 2.6	17.0 ± 3.4	<0.001	<0.001	0.02
Nutrition	9-36	16.7 ± 3.8	17.3 ± 4.0	0.054	22.3 ± 2.8	22.7 ± 3.1	0.09	<0.001	<0.001
Interpersonal Relations	9-36	13.2 ± 2.7	12.7 ± 3.6	0.053	14.3 ± 2.3	13.1 ± 2.7	<0.001	<0.001	0.085
Stress Management	8-32	14.3 ± 3.1	13.8 ± 3.4	0.055	19.3 ± 2.2	14.5 ± 3.8	<0.001	<0.001	0.008
Total score	52-208	103.0 ± 7.0	104.1 ± 7.4	0.057	132.4 ± 8.9	112.1 ± 6.8	<0.001	<0.001	<0.001
EORTC QLQ-C30									
Global Health Status	0-100	31.2 ± 18.0	33.8 ± 19.8	0.086	65.3 ± 11.9	54.3 ± 18.8	<0.001	<0.001	<0.001
Functioning dimensions									
Physical Functioning	0-100	41.8 ± 19.6	43.7 ± 18.1	0.201	63.3 ± 12.1	52.6 ± 18.0	<0.001	<0.001	<0.001
Role Functioning	0-100	26.8 ± 13.2	28.9 ± 14.3	0.056	61.3 ± 14.1	58.7 ± 17.2	0.04	<0.001	<0.001
Emotional Functioning	0-100	34.3 ± 13.1	32.9 ± 15.6	0.226	68.3 ± 15.4	56.6 ± 16.1	<0.001	<0.001	<0.001
Cognitive Functioning	0-100	37.6 ± 11.5	39.3 ± 11.7	0.065	43.3 ± 13.6	40.3 ± 18.4	<0.001	<0.001	0.373
Social Functioning	0-100	31.1 ± 14.6	33.3 ± 14.5	0.057	42.8 ± 16.7	41.7 ± 15.6	0.388	<0.001	<0.001
Symptom dimensions									
Pain	0-100	68.9 ± 21.0	67.3 ± 20.1	0.325	35.3 ± 15.7	36.2 ± 14.6	0.451	<0.001	<0.001
Fatigue	0-100	60.3 ± 19.7	62.9 ± 19.5	0.094	36.3 ± 10.1	48.4 ± 18.6	<0.001	<0.001	<0.001
Nausea and vomiting	0-100	46.8 ± 18.6	43.8 ± 19.9	0.051	25.3 ± 11.4	36.8 ± 13.1	<0.001	<0.001	<0.001
Dyspnea (shortness of breath)	0-100	43.9 ± 20.5	45.6 ± 21.6	0.311	33.3 ± 12.0	32.1 ± 12.8	0.225	<0.001	<0.001
Insomnia	0-100	56.0 ± 21.9	52.8 ± 22.0	0.066	41.3 ± 8.8	48.3 ± 13.2	<0.001	<0.001	<0.001
Appetite Loss	0-100	59.7 ± 22.2	56.6 ± 21.6	0.074	42.3 ± 9.4	53.1 ± 14.1	<0.001	<0.001	0.009
Constipation	0-100	43.9 ± 16.9	46.5 ± 18.7	0.068	31.3 ± 11.2	44.5 ± 17.9	<0.001	<0.001	0.134
Diarrhea	0-100	44.6 ± 20.1	46.4 ± 18.1	0.232	26.3 ± 10.8	28.4 ± 16.8	0.069	<0.001	<0.001

services and resources at rural healthcare facilities likely contributed to better patient outcomes, such as lower incidence of complications, leading to increased satisfaction [28]. Lastly, the continuous professional training provided to rural healthcare nurses may have translated into better communication and interpersonal skills, further enhancing patient satisfaction [30].

There are some limitations. Firstly, the study was conducted in a specific region, and thus, the findings may not be generalizable to other rural areas with distinct cultural, social, and economic contexts. Future research should aim to replicate the study in diverse settings to establish the generalizability of the medical consortium service model. Secondly, our study focused on the application of the medical consortium service model in the context of PICC placement for oncology patients, which might not be applicable to other medical disciplines or procedures. Investigating the effectiveness of the medical consortium service model in other healthcare areas, such as chronic disease management, surgery, and maternal and child healthcare, would be worthwhile.

We call for the long-term evaluation of medical consortium service because evidence about the sustainability and cost-effectiveness of this approach was limited, although this study had promising results. To build sustainable medical consortium service requires significant financial investment and infrastructure development. Therefore, it is essential to evaluate the cost-effectiveness of the medical consortium service and identify potential sources of funding to support its widespread adoption in rural areas. Additionally, maintaining the consortium system would require ongoing collaboration and communication between rural and urban healthcare providers, necessitating the development of robust strategies to facilitate seamless coordination and exchange of resources.

Conclusion

In conclusion, the application of a medical consortium service in rural areas for PICC placement among oncology patients demonstrated promising results in this prospective cohort study. The intervention was effective in reducing complications, improving patient satisfaction and compliance, enhancing health-related behaviors and quality of life. Further research is needed to explore the long-term benefits and cost-effectiveness of this approach, as well as its applicability in different healthcare settings.

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