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Visualization Exploration and Application Effect of Drug Configuration Process Based on Daytime Chemotherapy Interaction Design Information System

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Abstract: *Objective:* The purpose is to explore the full-process visualization of drug configuration based on the interactive design information system of daytime chemotherapy, and to discuss its application effect, in order to improve work efficiency, work quality and patient satisfaction. *Methods:* By means of information technology, the existing closed-loop management system of chemotherapy drugs in the hospital was extended to the patient end. A retrospective comparative analysis was conducted on the drug production time and patient satisfaction of the day chemotherapy center in our hospital before and after the application of this function. *Results:* After visualizing the entire process of drug configuration for patients based on the interactive design information system for daytime chemotherapy, the finished product time of each batch of drugs was shortened compared with that before application. Patient satisfaction has significantly improved. *Conclusion:* The visualization of the entire drug configuration process based on the interactive design information system for daytime chemotherapy can effectively improve the efficiency and quality of nursing work, and the satisfaction of daytime chemotherapy patients seeking medical treatment.

Keywords: Visualization; Chemotherapy updates; The entire process of drug preparation; Work efficiency; Satisfaction

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1. Introduction

In recent years, the number of cancer patients in China has been increasing continuously. In 2022, there were approximately 4.8247 million new cancer cases and 2.5742 million new cancer deaths per unit in China [1]. Chemotherapy is one of the important means of anti-tumor treatment for most cancer patients. With the increasing popularity of day chemotherapy [2], the construction of information systems has become one of the many difficulties in the development of day chemotherapy at present [3]. The construction of smart hospitals in our country has entered a stage of in-depth

implementation. By integrating digital technology with medical professional techniques, an interactive system among patients, medical staff, medical institutions and medical equipment is being established to build a patient-centered medical information platform gradually [4]. To meet the growing demands of patients, the process of information management for daytime chemotherapy is also accelerating [5]. Currently, many domestic hospitals have adopted information technology to meet their own needs at different stages of infusion closed-loop management [6]. Existing research mostly focuses on the transparency of internal information in the management of medical staff, nurses and drugs. However, there is still a lack of research on the visualization of drug configuration for patients.

The "14th Five-Year Plan for the Informatization of National Health" points out that the advantages of new-generation information technology should be fully leveraged to promote innovation in service models[7], advance "Internet + medical and health" services, continuously optimize the medical treatment process, constantly innovate medical service models, and improve the medical experience. As a shared chemotherapy platform for the entire hospital, the Day Chemotherapy Center of Sun Yat-sen University Cancer Center covers patients from all clinical departments, with an average of over 850 chemotherapy patients per day. It has a large-scale service practice scenario and operational foundation. Based on policy guidance and actual clinical needs, our hospital has currently implemented a closed-loop visual management of drugs in the intravenous administration center, achieving real-time sharing of drug information among medical, nursing, and pharmacy personnel. The three parties can monitor the infusion plan, drug status and infusion progress in real time, ensuring the traceability of drug use and the accuracy of information, and building a safety line for clinical medication. In order to provide patients with more accurate and personalized information sharing services, our hospital has built a patient visualization system for the entire process of drug configuration. We have launched a dynamic query function for chemotherapy on the hospital's APP, using information technology to achieve real-time, dynamic and visual management of pharmaceutical and nursing services. This has realized the closed-loop management of the entire process of chemotherapy infusion for patients and the full-process query of infusion drug information. It not only significantly improved the quality of nursing services, but also effectively enhanced patients' participation and satisfaction with their visits, providing a practical reference for the optimization of the information management model of day chemotherapy in China.

2. Materials and methods

2.1. Research data

A retrospective analysis was conducted to statistically analyze the time of chemotherapy drug configuration in the intravenous admixture service center of our hospital from January 2023 to October 2023. The satisfaction of patients who visited the day chemotherapy center during the same period was also collected. In addition, the job satisfaction of patients after the system function was launched was investigated. The period from January to May 2023 is before the system functions go live, and the period from June to October 2023 is after the system functions go live. This study has been approved by the Ethics Committee of the Clinical Medical Research Center of the hospital (No. B2025-539 -01).

2.2. Platform construction framework

2.2.1. Improve the closed-loop process of daytime chemotherapy.

The closed-loop process of chemotherapy drug infusion includes the intravenous admixture center's dispensing process and the nurse's execution of bedside medical orders. These two processes form a closed-loop process from the issuance of medical orders to the completion of chemotherapy drug execution. The closed-loop process management of infusion is conducive to the safety of patients' infusion, the integrity of drug information, and the improvement of the quality of nursing work. The closed-loop process diagram of chemotherapy infusion for patients in the day chemotherapy center of our hospital is shown in **Figure 1**. In the closed-loop process, pharmacists use PDAs bound to their personal information to record each step electronically. Delivery personnel collect finished infusions and deliver them to the corresponding infusion areas. Nurses use PDAs to assist in counting and checking for accuracy before receiving them, thus completing

the transportation and reception of finished drugs. During the execution of infusion medical orders, nurses use PDAs for human-machine verification and information recording. The execution records will be synchronized with the information system in real time. This process forms a complete closed-loop tracking chain with PDA as the carrier, ensuring that each link in the entire process is assigned to an individual. Visual management of the entire infusion process under information interaction - the medical, nursing and drug ports are shown in **Figure 2**.

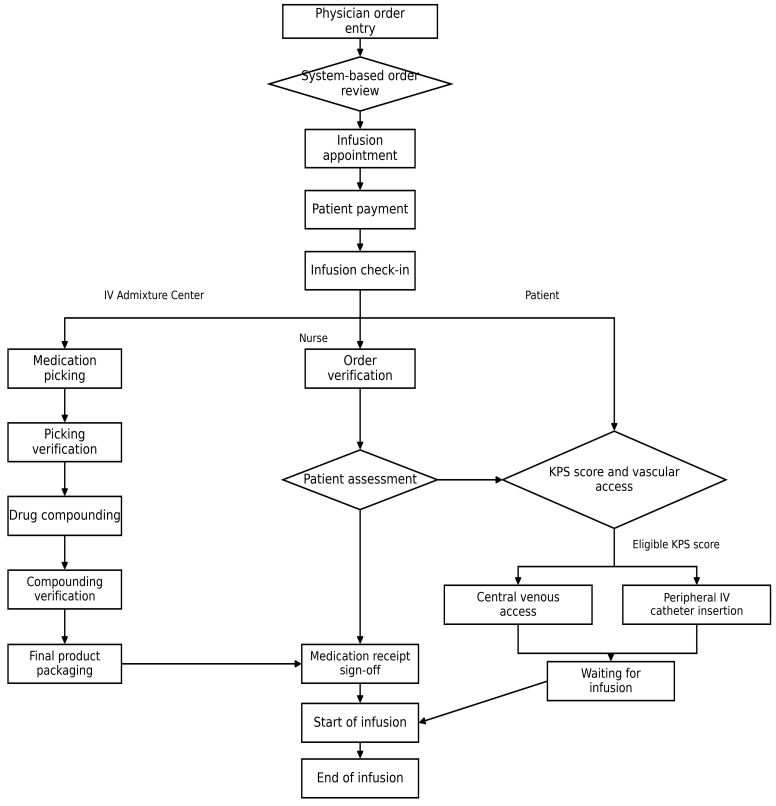

Figure 1. Optimized closed-loop chemotherapy-infusion workflow in the day chemotherapy center

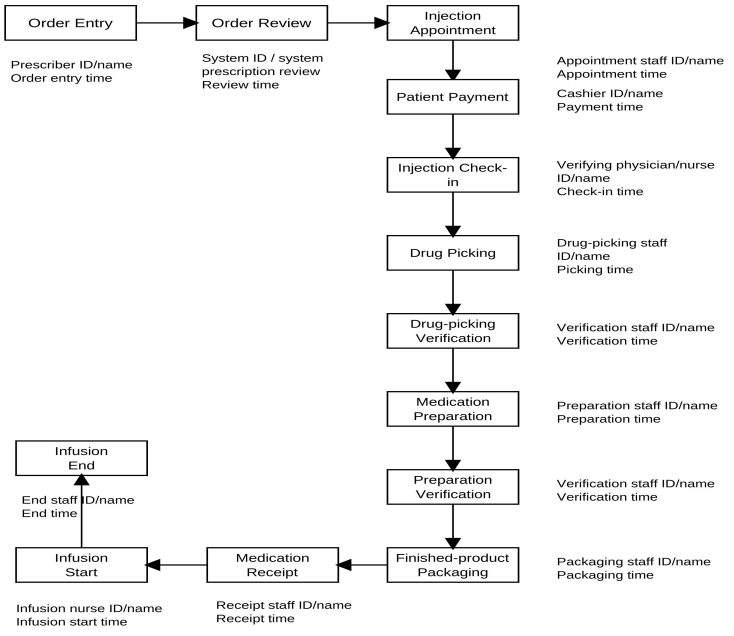

Figure 2. Visualized management of the full-process infusion workflow under information interaction - physician-nurse-pharmacist terminal

2.2.2. The chemotherapy dynamic query function on the patient side of the APP is supported by information technology.

Relying on the hospital APP, it is connected to the HIS system, PIVAS system, PDA system, and infusion and drug dispensing system, and the chemotherapy dynamic query function is launched to present the current status of the drugs to the patients. The information system architecture is shown in **Figure 3**. During the process of drug prescription review, configuration, transportation, and infusion, all operational information is scanned and recorded by the PDA. Patients can use the chemotherapy dynamic query function in the hospital's APP to check the current stage of the drug at any time, understand the execution time of each stage, and grasp the drug configuration and infusion information, thus avoiding frequent inquiries from nurses about the start time of drug treatment. It is convenient for patients to arrange other examinations or daily activities reasonably. It helps to reduce patients' anxiety levels, create a more comfortable, intelligent and convenient medical environment for them, and improve their medical experience. The patient-side path diagram of the full-process visual management of infusion under information interaction is shown in **Figure 4**.

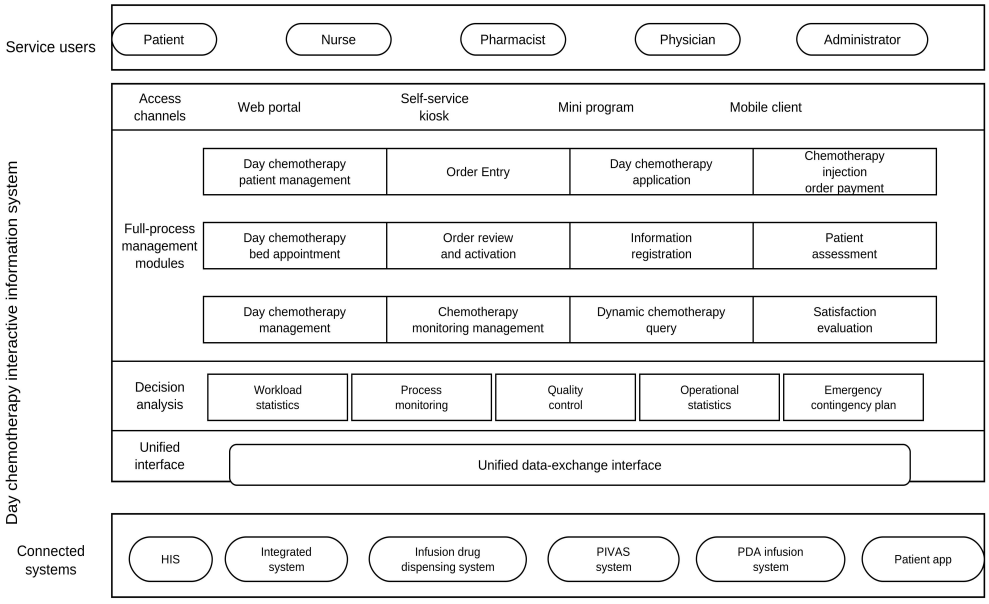

Figure 3. Information system architecture

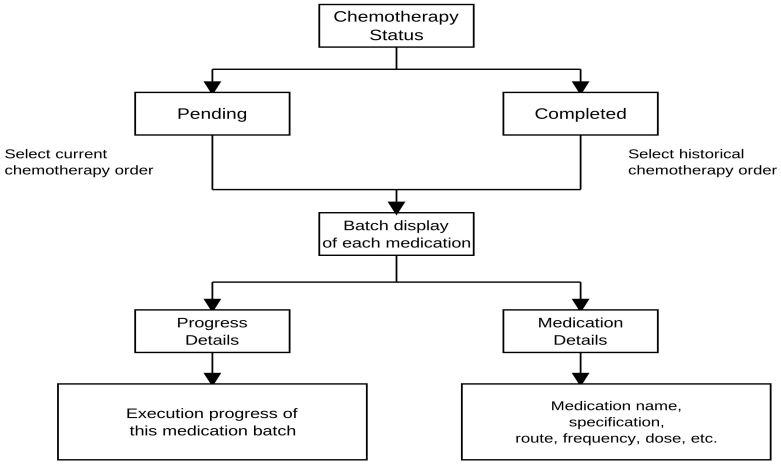

Figure 4. Patient-side pathway for daily visualized management of the full-process infusion workflow under information interaction

2.3. Evaluation Indicators

The time of finished drug products before and after application was traced back through the HIS system to the time from receiving medical orders to the infusion of finished drugs in the intravenous admixture service center, five months before and after the launch of this function. The average time of finished drug products for each batch on working days was analyzed and compared.

2.3.1. Self-made questionnaire on patient satisfaction

The questionnaire consists of two parts. The first part is the basic information of the patients, including gender, educational background, age, marital status, and the department they visit. The second part is a satisfaction survey, which includes four aspects: chemotherapy process, nursing operation, health education, and overall service, with a total of 10 questions. The Likert 5-level scoring method is adopted, and satisfaction is divided into five levels: very dissatisfied, dissatisfied, average, satisfied, and very satisfied, with corresponding scores ranging from 1 to 5, respectively, and the total score is 10 to 50. The Cronbach's α coefficient of this questionnaire is 0.947. Based on the patients' cooperation, a satisfaction survey was conducted by randomly selecting 150 patients (family members) from the day chemotherapy center before and after the launch of the dynamic query function for chemotherapy.

2.3.2. Statistical methods

The data on drug preparation time were collated using Excel. Descriptive analysis of the samples was conducted using IBM SPSS 26.0. The speed of drug preparation and patient satisfaction were expressed as M (P_{25}, P_{75}). The correlation between groups was tested using two independent non-parametric samples. Patient satisfaction was expressed as the mean plus or minus the standard deviation. Two independent sample t-tests were used for data between groups, and a P value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of the speed of finished drug products before and after application

The comparison of the finished product speed of each batch of drugs before and after application shows that during the peak periods of H11 and H12, which are the meal times for pharmacists to change shifts, the number of people preparing drugs has relatively decreased. Except for these two batches, the speed of the finished product of drugs has increased ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparison of the finished product speed of each batch of drugs before and after application

Batchtime	The speed of drug production before application (n = 101)	Speed of finished drug products after application (n = 103)		
	M (P_{25},P_{75})	M (P_{25},P_{75})	z	*p*
H03 8:30-9:00	66 (52.75,79.5)	48 (41,55.75)	-5.269	< 0.001
H04 9:00-9:30	73 (59,102.25)	47(38,54)	-6.619	< 0.001
H05 9:30-10:00	83 (63.25,110.5)	56 (43,65.75)	-5.565	< 0.001
H06 10:00-10:30	101.5 (86.5,117.75)	71.5 (59,81.75)	-6.108	< 0.001
H07 10:30-11:00	107.5 (92.25,132.5)	95 (74.25,110.5)	-2.986	< 0.001
H08 11:00-11:30	129 (99.25,158)	71.5 (59.25,81)	-7.723	< 0.001
H09 11:30-12:00	120 (96.5,159.5)	106 (91,134.75)	-2.043	0.041
H10 12:00-12:30	131(113,175.5)	121.5(96.75,143)	-2.805	0.005
H11 12:30-13:00	132.5 (109.5,189)	142.5 (128.25,169)	-1.208	0.227

Batchtime	The speed of drug production before application (n = 101)	Speed of finished drug products after application (n = 103)		
	M (P_{25},P_{75})	M (P_{25},P_{75})	z	*p*
H12 13:00-13:30	131 (110,210.5)	134 (109.5,153.75)	-1.077	0.282
H13 13:30-14:00	139.5 (118.25,182.75)	103.5 (84.75,125.25)	-4.740	< 0.001
H14 14:00-14:30	133.5 (120,177.25)	110 (78.25,133)	-3.882	< 0.001
H15 14:30-15:00	125.5 (107.25,168)	89.5 (61.5,110)	-5.710	< 0.001
H16 15:00-15:30	113 (90.25,153.5)	85 (62,100.75)	-4.254	< 0.001

3.2. Comparison of patient satisfaction before and after application

Patient satisfaction has significantly increased, with the total score rising from 42.75 ± 8.31 before application to 49.22 ± 1.47.

	Satisfaction before application (n = 150)	Satisfaction after application (n = 150)	t	*p*
Chemotherapy process	11.82 ± 3.17	13.79 ± 1.63	-6.754	< 0.001
Nursing operations	17.52 ± 3.26	19.33 ± 1.44	-6.241	< 0.001
Health education	4.41 ± 0.85	4.90 ± 0.30	-6.645	< 0.001
Overall service	8.63 ± 1.75	9.49 ± 0.90	-5.314	< 0.001

4. Discussion

4.1. The application of the patient visualization system function for the entire drug preparation process is conducive to improving the efficiency of drug production

By comparing the average drug production speed of each batch before and after the launch of this function, it is shown that after applying this function, except for the peak H11 and H12 batches, the time consumption of each stage of the entire drug preparation process has been reduced, and the preparation speed has increased compared with that before application ($p < 0.05$). During the peak period, there was no significant improvement in batches H11 and H12. The possible reasons for this might be that this period is the shift handover meal time, which led to the loss of hidden time. Additionally, this period is also the peak time for daytime chemotherapy patients, with a large number of prescriptions piling up instantly. Therefore, the speed of drug dispensing during this period did not improve. The improvement in the efficiency of the remaining batches indicates that the full-process visual management of infusion under information interaction has, to a certain extent, reduced the time consumption between each process and enhanced the efficiency of drug preparation. Thanks to the visual control throughout the entire information interaction process, it prompts the drug dispensing personnel to consciously follow the batch dispensing principle, reducing batch errors and omissions, and precisely dispensing batches. By providing patients with visual information simultaneously, it helps them clearly understand each step and the treatment process, increasing their sense of participation during chemotherapy [8,9], reducing additional communication and delays caused by doubts, lowering the pressure on nurses' non-medical behaviors, and enabling them to focus on core diagnosis and treatment services. It has achieved a dual improvement in internal work efficiency and the convenience of patients seeking medical treatment [10].

The application of the full-process visualization system function for drug preparation helps to enhance patient satisfaction. After the application of this function, patient satisfaction has been significantly improved ($P < 0.05$). Relevant studies have shown that the waiting time for patients is closely related to their medical treatment, physical examination and satisfaction [11]. Especially after registration, the waiting time for injection is shortened. The chemotherapy plan is lengthy, the drug dispensing process is complex, and the high requirements for drug preparation lead to an extended waiting time for infusion. Due to the fact that most cancer patients are concerned about the prognosis of their tumors, the side effects of treatment, the risk of recurrence, the quality of life and other uncertainties, patients are prone to varying degrees of stress

responses [12,13]. Under the traditional model, drugs are only visualized by medical staff, and patients cannot promptly know the exact start time of treatment, which easily leads to anxiety and frequent inquiries to nurses and pharmacists. At the same time, patients cannot accurately estimate the available medication time, making it difficult for them to plan their medical treatment for the day, such as arranging tests and examinations or outpatient visits. Even worse, due to patients leaving the infusion room, the timeliness of the infusion cannot be guaranteed. The visualization information of the entire infusion process reduces patients' unnecessary worries and anxieties, enhances their freedom of seeking medical treatment, and also improves their sense of gain from medical treatment, ultimately increasing patients' satisfaction with medical treatment [14].

4. Summary

In summary, the application of the full-process visualization function of drug configuration based on the daytime chemotherapy interactive design information system can effectively shorten the time-consuming process in all aspects of drug configuration in the static dispensing center, improve the quality of nursing work, and improve the patient's medical experience. The application of visualization of the entire drug process enables the visualization of drug configuration, infusion and other information to patients, but there are still deficiencies in the information transmission of medication knowledge. In order to improve patients' self-care abilities, provide personalized guidance on medication knowledge, and strengthen health education for patients and their families, it is essential [15]. However, the compact process and limited doctor-patient contact time of day chemotherapy make it difficult to fully carry out patient health education [16]. In the future, it is necessary to combine information technology, add medication guidance, side effects of chemotherapy and other related health education content, continue to optimize the nursing service process, innovate the nursing service model, and further improve patient satisfaction and diagnosis and treatment service quality.

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Disclosure statement

The author declares no conflict of interest.

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