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Study on the Impact of Network Information Management on the Compliance of Maintenance Hemodialysis Patients

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Abstract: This study focuses on the management of maintenance hemodialysis (MHD) patients, with a specific emphasis on the practical application effect of the network information management model including its impact on patients' compliance. A network information management model for MHD patients was constructed around three management schemes: "software reminders + follow-up guidance", "dietary records + self-management reminders", and "dialysis plan + precise weight management". These schemes were respectively used to optimize anemia management, control the risk of hyperphosphatemia, and improve toxin clearance efficiency. A controlled experiment was conducted, with an experimental group and a control group set up for comparative practice. The results showed that the network information management model can effectively improve patients' anemia, help alleviate mineral metabolism disorders and the accumulation of small-molecule toxins, and exert a positive impact on patients' treatment compliance.

Keywords: Network information management; Maintenance hemodialysis; Patients; Compliance; Impact

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1. Introduction

In the field of modern medicine, patients with end-stage renal disease (ESRD) mainly rely on maintenance hemodialysis for treatment and survival. For these patients, during long-term and regular dialysis treatment, they may experience compliance barriers due to physical and psychological issues. These barriers not only affect the treatment effect but may even lead to complications, thereby becoming a key factor influencing patients' quality of life and survival time. The traditional routine management model for MHD patients is mainly implemented through regular outpatient follow-ups, telephone communications, and other channels. However, this model faces problems such as slow information transmission, insufficient self-management ability of patients, and information barriers between doctors and patients. Therefore, against the backdrop of the "Internet +" era, the network information management model has become an important means to solve the above problems. Our hospital has adopted information-based management for hemodialysis since October 2022. This study was conducted based on

the SunTop Hemodialysis Information Management System developed by Data Intelligent Technology (Shanghai) Co., Ltd., aiming to specifically analyze the impact of network information management on the compliance of MHD patients.

2. Network information management model for maintenance hemodialysis patients

2.1. "Software reminder + follow-up guidance": Optimizing anemia management

As one of the common complications in maintenance hemodialysis patients, anemia directly affects patients' quality of life and even interferes with their survival prognosis. In patient management, erythropoietin (EPO) therapy is usually used for improvement, but patients have low compliance in this aspect, which has a negative impact on the treatment effect [1]. The network information management model adopts the method of "software reminder + follow-up guidance" for optimized management. By equipping with a dedicated health management software, it realizes functions such as personalized medical advice and medication reminders.

First, in terms of software reminders, its functions cover multiple methods, mainly including APP notification pushes, mobile SMS reminders, and built-in software alarms, to ensure that patients can receive timely medication prompts. At the same time, more detailed reminder content can be set up. In addition to the medication time, dosage and method, specific reminders will also help patients avoid problems such as missed doses and wrong doses [2]. Furthermore, the software can directly generate medication logs from the medication information and upload them to the system, allowing medical staff to remotely access and review the logs to understand the actual medication status.

Second, in terms of follow-up guidance, it mainly relies on online platforms to provide professional medical staff with remote follow-up and video guidance services. First of all, different follow-up frequencies can be set according to the condition status or treatment stage of different patients. Secondly, various follow-up forms such as video calls, voice calls, and online text communication can be selected based on the objectives of the follow-up activities [3]. The content of follow-up mainly includes medication reactions, physical sensations, and more. At the same time, it is also necessary to answer questions raised by patients, adjust the treatment plan according to the patient's situation at each stage, and reset the software reminder service. In addition, nutritional guidance services can be added to the follow-up process.

In particular, scientific and reasonable dietary plans are proposed based on the patient's anemia status and dietary preferences, and daily recommendations are provided through the software to improve the patient's nutritional status and enhance the effect of EPO treatment [4].

2.2. "Dietary record + self-management reminder": Controlling the risk of hyperphosphatemia

Maintenance hemodialysis patients are often affected by mineral metabolism disorders and thus suffer from hyperphosphatemia. If not controlled in a timely manner, it will significantly increase the risk of vascular calcification, cardiovascular events, and other complications, posing a direct threat to the patient's life safety. Generally speaking, the influencing factors of serum phosphorus levels are mainly reflected in the dietary aspect. However, maintenance hemodialysis patients lack awareness of scientific diet or have insufficient self-control ability, which leads to hyperphosphatemia [5]. In response to this, the network information management model proposes a "dietary record + self-management reminder" solution to solve this problem through health

management software.

First, through this software, patients can quickly record their daily dietary intake, including data such as food types and consumption amounts. Meanwhile, the software has a built-in database that stores information on the nutritional components and phosphorus content of common foods. When patients input their dietary records, the software can directly calculate their total phosphorus intake, helping patients keep real-time track of their dietary phosphorus consumption [6]. In addition, the software is equipped with an early warning function. Based on patient information, dialysis frequency, renal function status, and other factors, it can establish an accurate threshold index for phosphorus intake. When the phosphorus content from a patient's diet reaches this threshold, the software will automatically send an early warning notification [7].

Second, the software also features a patient self-management guidance function. On one hand, based on dietary records and blood phosphorus test results, the software can develop a personalized self-management plan for patients and send corresponding reminder messages in accordance with the plan. The reminder content mainly includes identifying high-phosphorus foods, scientifically selecting low-phosphorus foods, and learning dietary matching skills [8]. On the other hand, the software can regularly remind patients to undergo blood phosphorus tests and record the results, which are then used to generate statistical curves. These curves help medical staff gain a clear understanding of the patients' blood phosphorus changes [9].

Third, medical staff can not only view patients' data and information through the backend but also provide remote guidance based on this information to intervene in patients' self-management. Furthermore, the software platform can regularly invite experts in relevant fields, dietitians, and others to conduct online lectures, popularizing relevant knowledge and skills for patients.

2.3. "Dialysis regimen + precision management of dry weight": Enhancing toxin clearance efficiency

Removing metabolic toxins from the body is the core goal of maintenance hemodialysis and also the fundamental method to ensure the stability of patients' internal environment. Patient compliance and precision management of dry weight are key factors affecting the efficiency of toxin clearance. Once patients have compliance issues or improper dry weight control, they are prone to developing uremia, accompanied by symptoms such as pruritus and nausea [9]. In response to this, the network information management model proposes the "dialysis regimen + precision management of dry weight" program. Specifically, it utilizes a network information platform to record patients' dialysis-related information, including dialysis duration, frequency, blood flow rate, and dialysate formula, thereby improving patient compliance [10].

First, the software can set up dialysis reminders based on individual patient conditions. It notifies patients in advance through multiple channels to complete dialysis on time, preventing forgetfulness. Meanwhile, the software records detailed information and data of each dialysis session for patients, generates statistical charts from this data, and assists medical staff in monitoring dialysis effects in the background, conducting real-time analysis, and providing interventions and communications as needed [11].

Second, in terms of precision management of dry weight, patients can connect smart scales to the mobile app or manually input data to record their daily weight. The software platform uses large models to analyze factors such as historical weight records, dialysis regimens, and physical conditions [12]. If there is a significant fluctuation in the patient's condition, the platform will issue an early warning: on one hand, it reminds the patient to control fluid intake and weight gain; on the other hand, it notifies medical staff to pay special attention to the patient's

situation.

Third, the software platform can record toxin indicators such as blood urea nitrogen (BUN) and generate test reports based on these data, which in turn guide the development of subsequent treatment strategies and regimens.

3. Analysis of the impact of network information management on compliance of maintenance hemodialysis patients

3.1. Overview of methods

In this study, a controlled experiment was conducted, with an experimental group and a control group each consisting of 65 patients. The statistical significance of the groups met the required standards. The experimental group adopted the network information management model for maintenance hemodialysis patients, while the control group used the conventional management model.

3.2. Controlled experiment

During the experiment, both groups of patients had an observation period of 6 months. Throughout the observation period, the two groups received the same basic treatment plan and used identical dialysis equipment, dialysate, and medications. This was to ensure that the experimental results were not interfered with by other factors.

The experimental results were analyzed from three dimensions: First, indicator statistics: The main detection items included hemoglobin (Hb), blood phosphorus (P), blood urea nitrogen (BUN), creatinine (Scr), and blood potassium (K) [13].

Second, treatment compliance survey: The survey covered dietary compliance, fluid control, medication compliance, and adherence to the dialysis regimen [14]. Third, assessment of patients' mental state and quality of life: The evaluation indicators included the Self-Rating Anxiety Scale (SAS), Self-Rating Depression Scale (SDS), General Self-Efficacy Scale (GSES), as well as assessments of mental health, social relationships, environment, and overall quality of life [15].

3.3. Research conclusions

First, the monitoring results of indicator statistics are shown in **Table 1**.

Table 1. Statistical monitoring results of indicators in the control group and experimental group

Indicator	Control Group (n = 65)	Experimental Group (n = 65)	Statistical Significance
Hemoglobin (g/L)	102.7 ± 10.9	123.2 ± 13.2	$p < 0.05$
Serum Phosphorus (mmol/L)	2.18 ± 0.61	1.98 ± 0.55	$p < 0.05$
Blood Urea Nitrogen (mmol/L)	25.8 ± 6.9	23.2 ± 6.5	$p < 0.05$
Serum Creatinine (μmol/L)	941.5 ± 248.3	876.3 ± 266.8	$p < 0.05$
Serum Potassium (mmol/L)	5.11 ± 0.85	5.07 ± 0.76	$p < 0.05$

It is not difficult to find that through the implementation of the network information management model, the indicator data of patients in the experimental group have achieved remarkable results. Under schemes such as "software reminders + follow-up guidance", "dietary records + self-management reminders", and "dialysis plans + precise weight management", the patients' compliance with EPO treatment has been significantly improved.

Specifically, the average hemoglobin level increased by 20.5 g/L, the average blood phosphorus level decreased by 0.20 mmol/L, and the average blood urea nitrogen level decreased by 2.6 mmol/L. Although the changes in creatinine and blood potassium levels were not statistically significant ($p > 0.05$), the decrease in their mean values may have clinical significance.

Second, the survey results of treatment compliance were shown in **Table 2**. It was found that under the network information management model, the average score of patients' dietary compliance increased by 0.5 points, the average score of fluid control increased by 0.5 points, the average score of medication compliance increased by 0.4 points, and the average score of dialysis plan compliance increased by 0.4 points.

Therefore, it can be concluded that the network information management model indeed exerts a significant positive impact on patients' compliance.

Table 2. Survey results of treatment compliance in the control group and experimental group

Dimension	Control Group	Experimental Group	Significance
Dietary Compliance	3.3 ± 0.9	3.8 ± 0.7	$p < 0.05$
Fluid Control	3.0 ± 1.1	3.5 ± 0.9	$p < 0.05$
Medication Compliance	4.0 ± 0.8	4.4 ± 0.6	$p < 0.05$
Dialysis Regimen Adherence	3.7 ± 1.0	4.1 ± 0.8	$p < 0.05$
Total Score	69.5 ± 10.3	78.2 ± 8.5	$p < 0.05$

Third, the scores of patients' psychological status and quality of life are shown in **Table 3**. It can be observed that the total anxiety score and total depression score of patients have decreased significantly, while the self-efficacy score has increased noticeably. This indicates that the network information management model exerts a positive impact on patients' psychological status. Meanwhile, patients' scores in physical health, mental health, social relationships, environment, and overall quality of life have also increased, which similarly proves that the network information management model plays a positive role in improving patients' quality of life.

Table 3. Scores of psychological status and quality of life between the control group and the experimental group

Evaluation Indicators	Control Group	Experimental Group	*p*-value	Explanation of Inter-group Differences
SAS Total Anxiety Score	47.5 ± 7.6	43.2 ± 6.8	< 0.05	Reduction in anxiety symptoms
SDS Total Depression Score	51.9 ± 8.2	47.3 ± 7.5	< 0.05	Decrease in depression severity
GSES Self-Efficacy	24.5 ± 4.1	27.1 ± 3.6	< 0.05	Improvement in self-management ability
Physical Health	53.1 ± 10.5	57.3 ± 9.2	< 0.05	Enhancement of physical function
Mental Health	49.3 ± 9.9	53.5 ± 8.7	< 0.05	Improvement in emotional state
Social Relationships	62.8 ± 11.7	63.9 ± 10.9	0.28	No statistical difference
Environment	55.5 ± 9.8	57.8 ± 8.9	< 0.05	Influence of medical services
Overall Quality of Life	2.8 ± 0.9	3.2 ± 0.8	< 0.05	Increase in subjective satisfaction

4. Conclusions

To summarize, the network information management model exerts a positive impact on the compliance of patients undergoing maintenance hemodialysis. Firstly, it can optimize anemia management, effectively alleviate patients' anemia symptoms, reduce their blood transfusion needs, and ease both the economic burden on patients and the risks associated with blood transfusion. Secondly, this model can enhance patients' self-management ability, improve their cognitive level of high-phosphorus foods, achieve the effect of improving dietary control compliance, and thereby effectively reduce the risk of vascular calcification and the mortality rate of cardiovascular events. In addition, the model can also improve patients' compliance with dialysis plans, control their dry weight more accurately, and alleviate the accumulation of toxins in their bodies.

Disclosure statement

The authors declare no conflict of interest.

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