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Impact of the "Internet +" Pharmaceutical Care Model on Blood Pressure Control and Medication Safety in Patients with Hypertension

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Abstract [**Objectives**] To investigate the impact of the "Internet +" pharmaceutical care model on blood pressure control and medication safety in patients with hypertension. [**Methods**] This randomized controlled study enrolled 86 hypertensive patients treated at Guangxi International Zhuang Medicine Hospital from January 2023 to December 2024. Of these, 43 patients receiving standard medication guidance were assigned to the control group, while the other 43, who received the "Internet +" pharmaceutical care model, comprised the study group. Patient outcomes were assessed using the Morisky Medication Adherence Scale and the Self - Management Scale for Patients with Hypertension (SMSPH) on the day after admission (pre-intervention) and one month post-discharge (post-intervention). The analysis compared blood pressure levels between the two groups both before and after the intervention, and documented any adverse drug reactions occurring during the study period. [**Results**] Before the intervention, there were no significant differences between the two groups in Morisky scale scores, SMSPH scale scores, or blood pressure levels (systolic and diastolic) ($P > 0.05$). After the intervention, the scores on the Morisky scale and SMSPH scale in the study group were significantly higher than those in the control group ($P < 0.05$). In addition, the systolic and diastolic blood pressure levels in the study group were significantly lower than those in the control group and closer to the normal range ($P < 0.05$). The incidence of adverse drug reactions in the study group was significantly lower than that in the control group ($P < 0.05$). [**Conclusions**] The "Internet +" pharmaceutical care model is conducive to improving the rate of blood pressure control, medication safety, and adherence in patients with hypertension. It also helps patients acquire disease-related knowledge and correct unhealthy behaviors, which supports their long-term maintenance of both the behavior and cognition required for pharmacological treatment.

Key words Internet +, Pharmaceutical care model, Hypertension, Blood level, Medication safety

1 Introduction

Hypertension is a common and frequent chronic disease that endangers public health. According to the Blue Book on the Status of Hypertension Prevention and Control in China, the number of hypertension patients accounted for 26.4% of the adult population in 2021; however, the awareness rate and control rate were only 51.6% and 16.8%, respectively[1]. This indicates that the existing model of medication guidance for patients requires improvement. In the context of the "Healthy China 2030" strategy, it is necessary to explore effective, comprehensive, and personalized innovative models. Traditional pharmaceutical care can only provide patients with one-time, limited information, lacking continuity. The fixed form of education makes it difficult to form lasting memories, leading patients to abandon standardized medication habits after long-term treatment, while poor lifestyle habits may also induce diseases in other organs[2]. With the aid of Internet technology and smartphone applications in the era of big data to construct a new pharmaceutical care model enables physicians to understand patients' conditions anytime and anywhere. Simultaneously, it continuously records relevant information through data archiving functions for patients to review repeatedly. This not only strengthens medication adherence in chronic disease patients, popularizes knowledge such as medication schedules, and provides suggestions, but also offers patients certain spiritual support[3]. Through this approach, physicians' confidence in diagnosis and treatment can be enhanced, and patients' cooperation with long-term medication can be improved, thereby enhancing the control effect of chronic diseases like hypertension and ultimately achieving a closed-loop management system with positive physician-patient interaction. Therefore, this study selected 86 hypertension patients admitted to Guangxi International Zhuang Medicine Hospital from January 2023 to December 2024 as observation subjects, and the report is as follows.

2 Data and methods

2.1 General data A total of 86 patients with hypertension admitted to the hospital from January 2023 to December 2024 were selected for a randomized controlled study. 43 patients who received routine medication guidance were included in the control group, and 43 patients who received the "Internet +" pharmaceutical care model were included in the study group. Inclusion criteria were: age ≥ 18 years; diagnosed with essential hypertension and confirmed for the first time; proficient in using smartphones. Exclusion criteria were: secondary hypertension or gestational hypertension; complicated with organic lesions in other organs; being illiterate. The control group consisted of 21 males and 22 females, aged 39 to 51 years, with a mean age of (46.25 ± 5.42)

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years, and a disease course of 2 to 8 years. The study group consisted of 22 males and 21 females, aged 40 to 51 years, with a mean age of (46.31 ± 5.39) years, and a disease course of 2 to 9 years. There was no significant difference in baseline data between the two groups ($P > 0.05$).

2.2 Methods

2.2.1 Control group. Patients in the control group were only provided with routine medication guidance instructions. The instructions clearly specified the dosage, frequency, course of treatment, scheduled follow-up time, as well as medication contraindications and common manageable adverse reactions. Medical staff communicated with patients via telephone follow-up every Sunday from 15:00 to 16:00, with each session lasting 25 – 30 min, once a week, for one consecutive month.

2.2.2 Study group. Patients in the study group received an "Internet +" pharmaceutical care model, which primarily utilized a WeChat public platform. Before discharge, patients were invited to follow the hospital's official account and were registered via their inpatient ID in the backend. The public account featured two sections: a routine window and a personalized window. Through the routine window, medication guides, precautions (*e. g.*, hazards of missed or irregular medication), and related knowledge (*e. g.*, suitable and contraindicated foods) were pushed to patients every three days. Additionally, appointment reminders were sent based on the patient's condition. This window also offered a one-click keyword reply function. By clicking keywords such as "dizziness", "nausea", "diarrhea", or "bloating", patients automatically received corresponding handling suggestions and a prompt to contact the pharmacist promptly. The personalized window allowed patients to submit their weekly medication status (dosage, frequency, adherence, and adverse physical reactions) every Sunday. The pharmacist analyzed this information the following day and formulated personalized improvement measures. Patients could also consult the pharmacist about medication issues via this window at any time, with timely replies from the pharmacist. This intervention was continued for one month.

2.3 Observation indicators On the day after admission (pre-intervention) and at one month after discharge (post-intervention), patients' medication adherence, self-management level, blood pressure control, and medication safety were assessed. Medication adherence was evaluated using the 8-item Morisky Medication Adherence Scale, with a total score ranging from 0 to 8, and a score > 6 indicated high adherence[4]. Self-management level was assessed using the Self-Management Scale for Patients with Hypertension (SMSPH), with a total score ranging from 0 to 40, and a score > 30 indicated good self-management (determined based on the criterion that the proportion of patients with good management accounted for ≥50% of the surveyed population, $n = 125$)[5]. Blood pressure levels were measured as systolic blood pressure (SBP) and diastolic blood pressure (DBP), with the average of three measurements used for analysis, and the control targets were SBP < 130 mmHg and DBP < 80 mmHg. Medication safety was documented by recording adverse drug reactions occurring during the intervention period, such as dizziness, nausea, abdominal distension, and diarrhea.

2.4 Statistical methods SPSS 26.0 software was used for data analysis. Measurement data (blood pressure values and scale scores) were expressed as mean ± standard deviation, and comparisons between groups were performed using the *t*-test. Count data (incidence of adverse reactions) were expressed as number of cases (%), and comparisons between groups were performed using the χ^2 test. A *P*-value < 0.05 was considered statistically significant.

3 Results and analysis

3.1 Adherence As shown in Table 1, after the intervention, the Morisky scores of patients in both groups were significantly higher than those before the intervention, and the study group had significantly higher scores than the control group ($P < 0.05$).

Table 1 Comparison of Morisky scale scores between the two groups ($\bar{x} \pm s$, $n = 43$, points)

Group	Before intervention	After intervention	*t*	*P*
Study	3.25 ± 0.36	6.85 ± 1.41	6.468	<0.001
Control	3.35 ± 0.29	5.92 ± 1.21	3.984	<0.001
t	1.419	3.282		
P	0.160	0.002		

3.2 Self-management ability It can be seen from Table 2 that after the intervention, the scores of SMSPH in the two groups were significantly higher than those before the intervention, and the scores in the study group were significantly higher than those in the control group ($P < 0.05$).

Table 2 Comparison of SMSPH scores between the two groups ($\bar{x} \pm s$, $n = 43$, points)

Group	Before intervention	After intervention	*t*	*P*
Study	23.58 ± 2.31	35.23 ± 3.52	20.930	<0.001
Control	23.62 ± 2.29	33.02 ± 3.49	14.572	<0.001
t	0.081	2.924		
P	0.936	0.004		

3.3 Blood level As shown in Table 3, after the intervention, both systolic and diastolic blood pressure in the two groups were significantly lower than those before the intervention, and the blood pressure levels in the study group were significantly lower than those in the control group, being closer to the normal range ($P < 0.05$).

3.4 Adverse reaction As shown in Table 4, the incidence of adverse reactions in the study group was significantly lower than that in the control group ($P < 0.05$).

Table 3 Comparison of blood pressure levels between the two groups ($\bar{x} \pm s$, $n = 43$, mmHg)

Group	SBP		t	P	DBP		t	P
	Before intervention	After intervention			Before intervention	After intervention		
Study	158.26 ± 9.31	121.29 ± 3.48	66.419	< 0.001	98.36 ± 5.48	76.25 ± 3.21	39.722	< 0.001
Control	160.20 ± 8.43	131.20 ± 8.12	44.956	< 0.001	98.41 ± 5.39	85.25 ± 4.92	20.401	< 0.001
t	1.013	7.356			0.043	10.046		
P	0.314	0.000			0.966	0.000		

Table 4 Comparison of adverse reactions between the two groups [$n = 43$, n (%)]

Group	Dizziness	Nausea	Abdominal distension	Diarrhea	Total incidence
Study	0 (0.00)	0 (0.00)	1 (2.33)	1 (2.33)	2 (4.65)
Control	3 (6.98)	1 (2.33)	2 (4.65)	2 (4.65)	8 (18.60)
X^2					4.074
P					0.044

4 Discussion

The results demonstrated that following the intervention, both systolic and diastolic blood pressure in the study group were significantly lower than those in the control group ($P < 0.05$) and fell closer to the normal range. This finding aligns with the research by Han Dan *et al.* [6], which explored multi-party collaborative management for elderly hypertensive patients. The underlying reasons may be as follows: The personalized window of the WeChat platform enabled pharmacists to monitor patient medication adherence in real time, promptly addressing inappropriate medication practices and minimizing the risks of missed or incorrect doses. Moreover, the model required weekly submission of medication records, with pharmacists providing timely feedback and personalized improvement strategies the following day. This established a closed-loop system of "feedback-monitoring-improvement," effectively overcoming common limitations of traditional telephone follow-ups, such as unanswered calls or communication barriers. By fostering continuous cyclical supervision of medication behaviors, the model likely contributed to the development of "muscle memory" in patients. Combined with educational content delivered through the daily window, patients were empowered to acquire essential self-management skills, optimize lifestyle habits, and ultimately prevent disease progression or complications.

This study showed that the incidence of adverse drug reactions in the study group was significantly lower than that in the control group ($P < 0.05$), a finding consistent with the study by Li Luyi *et al.* [7], indicating that the Internet-supported pharmaceutical care model can reduce erroneous behaviors such as self-discontinuation, self-switching, or dose reduction, thereby avoiding consequent physical harm. The mechanism for this improvement lies primarily in the regular dissemination of medication guides to patients, combined with education on the impact of poor medication adherence on disease recovery, which enhanced patients' awareness of the importance of taking medication as prescribed. In addition, the personalized window of the public account provided timely and effective answers and corrections to patients' questions regarding medication administration methods, drug-drug interactions, and drug-food interactions[8]. Compared with traditional pharmaceutical care, paper-based medication guides are simplistic and lack expandability, making it difficult to stimulate patients' motivation for continuous learning, while telephone follow-ups have limited timeliness. The "Internet +" pharmaceutical care model is more humanized and timely.

The findings further revealed that patients in the study group demonstrated significantly greater improvements in medication adherence and self-management ability compared to those in the control group ($P < 0.05$), underscoring the human-centered advantages of the "Internet +" pharmaceutical care model. Within the "behavior-evaluation-reinforcement" cycle—wherein patients submitted weekly medication reports via the personalized window and received tailored guidance from pharmacists—repetitive learning occurred, effectively mitigating adherence issues stemming from forgetfulness or inattention[9]. Moreover, pharmacists' positive feedback and encouragement bolstered patients' confidence and hope in managing their disease, particularly among those experiencing heightened negative emotions or newly diagnosed individuals. Beyond accessing information through the official account, patients also leveraged other online platforms to independently expand their disease-related knowledge[10].

In conclusion, the "Internet +" pharmaceutical care model effectively promotes regular and standardized medication practices among hypertensive patients, mitigating the negative effects of inappropriate behaviors on disease outcomes. Nevertheless, this study is limited by its short observation period and the lack of age-based subgroup analysis. Future research with extended follow-up and refined stratification is warranted to confirm its sustained benefits.

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