



Effectiveness of the "Internet-Plus"-Based Life-Cycle Management on Pediatric Chronic Diseases

Jing Liu¹, Hongying Nie², *Fan Rao¹

1. Department of Pediatric Comprehensive Internal Medicine, Three Gorges Hospital Affiliated to Chongqing University, Chongqing, 404100, China
2. Department of Pediatrics, Wushan County People's Hospital, Chongqing, 404700, China

*Corresponding Author: Email: hy197562315@163.com

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Abstract

Background: We aimed to assess the effect of life-cycle management on the satisfaction and health outcomes of children with chronic diseases and their parents, as well as the career benefits of healthcare workers.

Methods: Participants were children with chronic diseases who received long-term treatment at the Three Gorges Hospital Affiliated to Chongqing University from January 2021 to November 2022. From the first admission, compare the children's disease onset, satisfaction and professional benefits of medical staff among "Medical and Nursing Integration" + "Internet plus"-based life cycle management group (n = 221, the experimental group), the routine management group (n = 53, the control group 1) and the "Medical and Nursing Integration" group (n = 67, control group 2).

Results: The overall satisfaction of children in the experimental group (100 %) was higher than that in the control group 1 (98.11%) and control group 2 (98.51%). The times of second admission and third admission of patients in the experimental group were significantly lower than those in control group 1 were (both $P < 0.001$) and control group 2 (both $P < 0.01$). Nurses' sense of professional benefit, professional identity, and doctor's satisfaction with nurses in the experimental group were significantly higher than those in control group 1 ($P < 0.05$, $P < 0.01$, $P < 0.001$) and control group 2 (all $P < 0.05$).

Conclusion: The application of "Medical and Nursing Integration" + "Internet plus"-based life cycle management in chronic disease nursing management can effectively improve the management on pediatric chronic diseases.

Keywords: Disease; Public health; Children; Nursing

Introduction

The etiology of chronic diseases is relatively complex, it is not easy to be discovered in the early stage of the disease, and it has the characteristics of long course of disease, repeated illness and difficult to cure (1). In order to improve the

efficiency and effectiveness of chronic disease management and reduce the risk of patient deterioration, health service institutions need to provide chronic disease patients with an integrated chronic disease management service that inter-



venes throughout the disease cycle (2). In recent years, the prevalence and incidence of chronic diseases in Chinese children have gradually increased, and the phenomenon of younger age of chronic diseases has become increasingly prominent. Chronic disease in children has become one of the public health problems of global concern, and its prognosis is closely related to whether the patient can continue to receive effective disease management after discharge. Therefore, providing continuous care for children with chronic diseases is a necessary means for the management of children with chronic diseases (3).

With the continuous development and popularization of Internet technology, it is used as an auxiliary tool to provide long-term health services and medical guidance to patients in more and more chronic disease medical fields. Internet medical service is proposed under China's "Internet plus" action plan policy. Simply put, it is a model that combines traditional medical care with modern Internet medical care, online and offline (4). As an important part of e-health, it provides solutions for optimizing the allocation of medical resources, coping with the threat of chronic diseases and improving the quality of life of patients.

Continuous nursing care for children with chronic diseases are mainly telephone visits and the establishment of chronic disease health records, which are single in form and unsatisfactory in effect. Domestic scholars have reported that the continuous nursing service model is used in the chronic disease management of single diseases such as children with cerebral palsy, epilepsy, asthma, and diabetes. This continuous care is mainly based on specialized nurses, who cooperate with doctors, patients and their families to carry out care during hospitalization and after discharge (5-9). However, the studies carried out by different scholars are different, and there are relatively few systematic studies.

How build a service model suitable for children's chronic disease management with the assistance of Internet to meet the needs of children with chronic diseases is an urgent problem to be solved. Based on the concept of "health-

centered", we explored the nursing service process of children with chronic diseases throughout the disease cycle from outpatient clinic to discharge. In addition, we evaluated and analyzed the practical effect of nurses participating in the whole life cycle health management of children with chronic diseases. The innovation of this project lies in the development of the "Medical and Nursing Integration" mode, which builds an online and offline interactive chronic disease service model based on "Internet plus", aiming to provide a reference for the construction of a full life cycle health management model for children with chronic diseases.

Materials and Methods

Experimental design

A three-arm parallel controlled trial was used to evaluate the health management effect and doctor-patient satisfaction of an Internet-based "health-centered" care model on children with chronic diseases.

Clinical data

Participants were children and their guardians who received long-term treatment at the Three Gorges Hospital Affiliated to Chongqing University, China from January 2021 to November 2022. According to the order of admission of children with chronic diseases, the recruitment of participants was based on the following inclusion criteria: a. Children aged 0 to 18 years, who were diagnosed as meeting the criteria for neurocardiovascular disease, respiratory disease, or digestive blood kidney disease.

Exclusion criteria are as follows: a. children and guardians who cannot communicate well with researchers; b. children who live outside the city for medical treatment; and c. left-behind children who cannot effectively use the "Internet plus" communication.

This study has been approved by the Ethics Committee of the Three Gorges Hospital Affiliated to Chongqing University. Participating children and their guardians were informed about the

study and its purpose. They signed informed consent.

Interventions

Routine chronic disease care

In the children's digestive blood kidney disease area (chronic kidney disease, systemic lupus erythematosus, chronic leukemia), only nurses and doctors conducted ward rounds and chronic disease management, and set it as control group 1.

"Medical and Nursing Integration"

Children's respiratory disease area (asthma) carried out the "Medical and Nursing Integration" mode, where nurses follow doctors to make ward rounds and manage chronic diseases, and they are set as control group 2.

"Health-centered" full life cycle health management model based on "Internet plus"

"Health-centered" nursing model was carried out in the children's neurocardiovascular disease area (epilepsy, diabetes, congenital heart disease, hypertension), and set it as experimental group. Nursing staff participated in the health management of all children with chronic disease admitted in the ward, and provide children with medical care from the "Medical and Nursing Integration" outpatient clinic to discharge (utilize the "Internet plus" professional medical team and nurses in the Pediatric Care Department to carry out continuous nursing guidance for children such as child care, growth and development assessment, medication treatment and nursing precautions for other common diseases, community health spectrum, and family visits).

The three groups of nurses in the three wards had no difference in age, professional title, education, work experience, etc.

Data Collection

Follow-up Compliance

From the first admission of the children until the end of the study, record the number of follow-up consultations in specialist/"Medical and Nursing Integration" outpatient clinics, professional nurse consultations, Internet visits, effective telephone

return visits, WeChat group visits and home visits for children in the control group 1, control group 2, and the experimental group. The number of follow-up visits was counted 1-2 weeks after discharge.

The frequency and degree of disease attacks, and the occurrence of complications

After the first admission of children, the number of admissions and the number of severe cases and deaths in each ward during the study period were recorded.

Patient and family satisfaction

After the end of the clinical study, a satisfaction survey was conducted on the children and their guardians in each group. From January to November 2022, each child and its guardians jointly filled out the satisfaction survey. The questionnaire options included "very satisfied", "satisfied", "relatively satisfied", and "dissatisfied". The researchers contacted the directors of relevant departments and head nurses, explained the purpose, significance, and filling methods of the survey to them with unified instructions, and checked the questionnaires in time after they were returned.

Nurses' sense of professional value

The nurses in each ward were surveyed on the sense of professional benefit (questionnaire 1) and nurses' professional identity (questionnaire 2) (10). There were 33 questions in questionnaire 1 and 30 questions in questionnaire 2. The options in the two questionnaires included "strongly disagree" (0 point), "disagree" (1 point), "not sure" (2 points), "somewhat agree" (3 points), "very agree" (4 points).

Doctors' satisfaction with nurses

Doctors in three wards were surveyed on their satisfaction with nurses. There was a total of 11 questions in the questionnaire, and the options included "very satisfied" (4 points), "satisfied" (3 points), "general" (2 points), and "dissatisfied" (1 point). The total score of the questionnaire was 44 points.

Data Analysis

Data were processed using SPSS 18.0 statistical software (Chicago, IL, USA). The enumeration data were expressed as case number, and the χ^2 test was used for analysis. The measurement data conforming to the normal distribution were expressed as mean \pm standard deviation, and the t test was used for analysis. $P < 0.05$ was considered statistically significant.

Results

Basic information of the children

The basic information of the children admitted to the three wards where the experiment was carried

out in our hospital from January 2022 to November 2022 is listed in Table 1. During the study, the experimental group excluded 3 cases (1 child with epilepsy suffered from brain tumor; 1 child with hypertensive blood suffered from kidney tumor; 1 child with diabetes lived outside the city), and the control group excluded 2 cases (1 child with chronic myelogenous leukemia turned into an acute attack; 1 child with systemic lupus erythematosus was a left-behind child whose family members did not have a smartphone), and 1 case was excluded from the control group 2 (1 child with asthma lived outside the city for a long time).

Table 1: Basic information of children

<i>Variable</i>		<i>Control group 1 (n=53, %)</i>	<i>Control group 2 (n = 67, %)</i>	<i>Experimental group (n = 221, %)</i>
Gender	Male	32 (60.4)	31 (46.3)	116 (52.5)
	Female	21 (39.6)	36 (53.7)	105 (47.5)
Age (yr)	0-3	17 (32.1)	10 (14.92)	108 (48.9)
	4-7	13 (24.5)	38 (56.7)	46 (20.8)
	7-12	10 (18.9)	14 (20.9)	48 (21.7)
	>12	13 (24.5)	5 (7.5)	19 (8.6)
Permanent residence	Countryside	27 (50.9)	28 (41.8)	112 (50.7)
	Town	26 (49.1)	39 (58.2)	109 (49.3)
Guardian education	Junior high school and below	12 (22.6)	20 (29.9)	82 (37.1)
	High School (Technical Secondary School)	28 (52.8)	32 (47.7)	98 (44.3)
	College and above	13 (24.5)	15 (22.4)	41 (18.6)

Follow-up compliance of children

The follow-up compliance of the children was shown below (Table 2). In the experimental group, the return visit rate was 4 times higher than that in the control group 1. In terms of children's follow-up compliance, the consulting rate in the experimental group was almost doubled

compared with that in the control group 2. The Internet consultation rate of the control group 2 was lower than that of the control group 1. The effective telephone return rate of control group 1 and control group 2 showed similar results and the effective telephone return rate of the experimental group was higher.

Table 2: Follow-up compliance of children

<i>Return visit</i>	<i>Control group 1 (n=53, %)</i>	<i>Control group 2 (n=67, %)</i>	<i>Experimental group (n=221, %)</i>
Specialist /Medical and Nursing Integrated Out-patient Clinic	64 (120.75)	236 (352.24)	1075 (486.43)
Professional nurse consultation	/	82 (122.39)	512 (231.67)
Internet consultation	43 (81.13)	46 (68.66)	247 (111.76)
Effective telephone return visit	48 (90.57)	61 (91.04)	341 (154.3)
Specialist WeChat group consultation	/	/	464 (209.95)
Home visit	/	/	15 (6.79)

The frequency of disease attacks, the degree of attacks and the occurrence of complications

As shown in Table 3, the number of secondary admissions in the experimental group was significantly lower than that in the control group 1 ($P<0.001$) and control group 2 ($P<0.01$). Similarly, the number of hospital admissions of three

times or more in the experimental group was also significantly lower than that of control group 1 ($P<0.001$) and control group 2 ($P<0.01$). During the period of the clinical trial, there were no children in the experimental group who became critically ill or died, but there were critically ill/dead children in both control group 1 and control group 2.

Table 3: Disease onset

<i>Project</i>	<i>Control group 1 (n=53, %)</i>	<i>Control group 2 (n=67, %)</i>	<i>Experimental group (n=221, %)</i>	<i>Experimental group vs. Control group 1</i>		<i>Experimental group vs. Control group 2</i>	
				χ^2	<i>P</i>	χ^2	<i>P</i>
First admission	25 (47.17)	27 (40.3)	107 (48.42)				
Second admissions	18 (33.96)	17 (25.37)	26 (11.76)	15.626	<0.001***	7.496	0.006**
Three or more admissions	11 (20.75)	9 (13.43)	6 (2.72)	23.906	<0.001***	11.963	0.002**
Turned into severe disease	2	1	0				
Death case	1	1	0				

Satisfaction of children and their families

As shown in Table 4, when conducting satisfaction surveys on children and their families, we found that "very satisfied" in the experimental group were higher than those in the control

group 1 and control group 2. Moreover, in control group 1 and control group 2, there were "dissatisfied" with the visit to the doctor, and in the experimental group, no child or family member felt "dissatisfied".

Table 4: Satisfaction of children and their families

<i>Variable</i>	<i>Very satisfied</i>	<i>Satisfy</i>	<i>Relatively satisfied</i>	<i>Dissatisfied</i>
Control group 1 (n =53, %)	18 (33.96)	30 (56.60)	4 (7.55)	1 (1.89)
Control group 2 (n=67, %)	36 (53.73)	27 (40.30)	3 (4.48)	1 (1.49)
Experimental group (n =221, %)	20 (94.57)	10 (4.52)	2 (0.90)	0

Degree of occupational benefits of medical staff

As shown in Table 5, the professional benefit score of the nurses working in the ward of the experimental group was significantly higher than that of the nurses in the control group 1 ($P<0.05$) and control group 2 ($P<0.05$). In addition, the

professional identity of the nurses in the experimental group was also significantly higher than that of control group 1 ($P<0.01$) and control group 2 ($P<0.05$). Doctors in the experimental group were significantly more satisfied with the nurses in this group than those in control group 1 ($P<0.001$) and control group 2 ($P<0.05$).

Table 5: Occupational benefits of medical staff

Variable	Control group 1	Control group 2	Experimental group	Experimental group vs. Control group 1		Experimental group vs. Control group 2	
				t	P	t	P
Nurses' sense of professional benefit	99.77 ± 8.849, n=22	99.38 ± 11.93, n=13	122.9 ± 3.033, n=18	2.271	0.0289*	2.199	0.0360*
Nurses' professional identity	79.82 ± 7.426, n=22	85.68 ± 7.679, n=22	106 ± 3.342, n=18	2.988	0.0049**	2.251	0.0303*
Doctor satisfaction with nurses	32.55 ± 2.349, n=11	35.62 ± 2.928, n=13	43.09 ± 0.6668, n=11	4.319	0.0003***	2.299	0.0314*

Discussion

The "Medical and Nursing Integration" mode is to enable medical staff to work more closely with each other, clarify responsibilities, and learn from each other's strengths to further improve the clinical effect of treatment and nursing (11, 12). In terms of chronic disease management practices, China has now incorporated part of the content of chronic disease management into the national basic public health service items, and provided them to community residents as basic public services. In order to promote the implementation of the hierarchical diagnosis and treatment system and promote the formation of a reasonable medical treatment order in some areas, chronic disease management is also used as a breakthrough, aiming to guide patients to stay at the grassroots level for medical treatment (13, 14). This study found that the full-life cycle chronic disease management based on the "Medical and

Nursing Integration" mode can enable children to have consistent medical management, significantly reduce the times of disease recurrences in children, improve children's satisfaction with medical treatment, and strengthen the professional identity of medical staff. The chronic disease management model of the whole life cycle transforms the management of children's chronic diseases from passive diagnosis and treatment to active health, mobilizes the initiative of children's families in self-health management, and fundamentally promotes the advances in public health. How to make patients with chronic diseases more actively participate in the process of disease management has always been an urgent problem to be solved. Ramelet et al (15) conducted a multi-centered, randomized, longitudinal, crossover trial to investigate the effects of a telephone intervention (TN, providing personalized emotional support, health information, and decision-making assistance, etc.) in pediatric patients with

inflammatory rheumatic diseases. They found that after 12 months of TN, children's satisfaction was significantly higher (OR = 7.7, 95% CI: 1.8-33.6) compared with the control group, and morning stiffness (OR = 3.2, 95% CI: 0.97-7.15) and pain (OR = 2.64, 95% CI: 0.97-7.15) were lower. In this study, we found that the whole life cycle management mode could improve the initiative of families of children with chronic diseases in disease management. Children in the whole life cycle management group showed higher satisfaction with visits to the doctor and a higher return visit rate, and the number of disease recurrences was significantly reduced. Likewise, previous research has found that diabetic patients treated under the PRECEDE-PROCEED model [combining PRECEDE (predisposing, enabling and reinforcing constructs in educational diagnosis and evaluation) with PROCEED (policy, management and organization constructs in educational and environmental intervention)] showed lower levels of FPG, 2hPG and HbA1c than the conventional group (all $P < 0.05$). Moreover, the awareness rate, self-efficacy, self-management level, and quality of life scores of the PP group were higher than those of the routine group were (all $P < 0.05$). These results collectively demonstrate the effectiveness of life-cycle management for chronic disease management (16).

In addition, our research also found that this full life cycle management model could also improve the professional benefits of medical staff. In the process of promoting the development of national public health, not only the patient's disease status and long-term disease management status should be paid attention to. As an important part of public health, the mental health of medical staff also needs to be paid attention. The high load of clinical work tasks makes medical staff a high-risk group of mental illness problems (17, 18), and mental exhaustion is common. A cross-sectional study conducted in Liaoning Province, China from December 2017 to January 2018 showed that the prevalence of chronic fatigue syndrome among nurses was 6.76% (19), which indicated that the working mode of the nurse position needed to be optimized. We found that in

the experimental group, the nurses' sense of professional benefit and professional identity were significantly higher than those of the control group 1 ($P < 0.05$, $P < 0.01$) and control group 2 (both $P < 0.05$), which means that the whole life cycle management mode can effectively improve the phenomenon of mental exhaustion. Moreover, the full life cycle of "Medical and Nursing Integration" model of medical care make the work of doctors and nurses tacit. The experimental group of this study showed that doctors' satisfaction with nurses was significantly improved, which further increased clinical work efficiency.

Conclusion

The "Internet plus"-based life-cycle health management model for children with chronic diseases effectively combines emotional support, health consultation and decision-making assistance for children. This health management method reduces the disease recurrence of children, improves the satisfaction of children with chronic diseases and their families. In addition, the health management model improves the professional identity and promotes the professional cooperation ability of nurses. The "Internet plus"-based whole life cycle health management model of children with chronic diseases proposes a feasible long-term care plan for public health.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The authors declare that there is no conflict of interest.

References

1. Dale MT, Elkins MR (2021). Chronic disease. *J Physiother*, 67: 84-86.
2. Chan SW (2021). Chronic Disease Management, Self-Efficacy and Quality of Life. *J Nurs Res*, 29: e129.
3. Berry JG, Bloom S, Foley S, Palfrey JS (2010). Health inequity in children and youth with chronic health conditions. *Pediatrics*, 126 Suppl 3: S111-119.
4. Liang G, Jiang H, Huang C, Que X, Tang J, Lu J, Gao J (2020). Diabetes health management strategy based on internet plus graded diagnosis and treatment strategy. *Ann Palliat Med*, 9: 3915-3922.
5. Akchurin OM (2019). Chronic Kidney Disease and Dietary Measures to Improve Outcomes. *Pediatr Clin North Am*, 66: 247-267.
6. Chen B, Kessi M, Chen S, et al (2020). The Recommendations for the Management of Chinese Children With Epilepsy During the COVID-19 Outbreak. *Front Pediatr*, 8: 495.
7. Hamilton H, Knudsen G, Vaina CL, Smith M, Paul SP (2017). Children and young people with diabetes: recognition and management. *Br J Nurs*, 26: 340-347.
8. Larson-Nath C, Goday P (2019). Malnutrition in Children With Chronic Disease. *Nutr Clin Pract*, 34: 349-358.
9. Naja AS, Permaul P, Phipatanakul W (2018). Taming Asthma in School-Aged Children: A Comprehensive Review. *J Allergy Clin Immunol Pract*, 6: 726-735.
10. Hu J, Liu X (2013). Establishment of a questionnaire of nurses' perceived professional benefits: reliability and validity assessment. *Nurs J Chin PLA*, 022:030.
11. Chen F, Jiang Q, Lu Z, Cao S (2021). General practitioners' perspectives of the integrated health care system: a cross-sectional study in Wuhan, China. *Fam Pract*, 38: 103-108.
12. Jiang Q, Lou Y, Chen F, Lu Z, Cao S (2022). Keys to promoting the graded diagnosis and treatment system based on the integrated health care system in China. *Fam Pract*, 39: 217-218.
13. Ding H, Chen Y, Yu M, et al (2021). The Effects of Chronic Disease Management in Primary Health Care: Evidence from Rural China. *J Health Econ*, 80: 102539.
14. Ling D, Wang R, Chen Q, et al (2021). Assessment of chronic disease management mode (CDMM) on participants with primary hypertension. *Trop Med Int Health*, 26: 829-837.
15. Ramelet AS, Fonjallaz B, Rio L, et al (2017). Impact of a nurse led telephone intervention on satisfaction and health outcomes of children with inflammatory rheumatic diseases and their families: a crossover randomized clinical trial. *BMC Pediatr*, 17: 168.
16. Kan W, Yang R, Tang M (2021). Application research of chronic disease health management in an urban community based on the PRECEDE-PROCEED model in the long-term management of diabetes mellitus. *Am J Transl Res*, 13: 8142-8149.
17. Melnyk BM, Kelly SA, Stephens J, et al (2020). Interventions to Improve Mental Health, Well-Being, Physical Health, and Lifestyle Behaviors in Physicians and Nurses: A Systematic Review. *Am J Health Promot*, 34: 929-941.
18. Saragih ID, Tonapa SI, Saragih IS, Advani S, Batubara SO, Suarilah I, Lin CJ (2021). Global prevalence of mental health problems among healthcare workers during the Covid-19 pandemic: A systematic review and meta-analysis. *Int J Nurs Stud*, 121: 104002.
19. Li M, Shu Q, Huang H, Bo W, Wang L, Wu H (2020). Associations of occupational stress, workplace violence, and organizational support on chronic fatigue syndrome among nurses. *J Adv Nurs*, 76: 1151-1161.