

Online Nutritional Management in Children with Congenital Heart Disease in the Context of COVID-19: A Prospective Study

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Abstract

Objective: Children with congenital heart diseases (CHD) require multiple follow-ups at the hospital (including nutritional assessment), increasing the risk of nosocomial infection with the SARS-CoV-2. The study aimed to examine the online control management model on the well-being of children with CHD during the COVID-19 pandemic. **Methods:** This prospective study was conducted in patients with CHD in the Department of Cardiology of Chengdu Women's and Children's Central Hospital between February and July 2020. Through the establishment of the NMT team and the adoption of the "Internet plus" approach, the families of the children with CHD were given professional counseling, intervention, guidance online, a service system of disease and psychological counseling, and self-assessment. The satisfaction survey on the family members of the CHD children were conducted using two microcodes of hospital standard satisfaction questionnaire. **Results:** There were 72 patients with CHD enrolled in this study. The online consultations prevented 18 children from visiting the hospital. Since they were always accompanied by at least one relative, it effectively reduced at least 36 individuals of being exposed to COVID-19. None of the 72 children suffered from delayed diagnosis and treatment or irregular long-term management due to the influence of the epidemic. The average satisfaction after the intervention was higher than before the intervention (98.3 ± 2.8 vs. 95.1 ± 6.5 , $P=0.048$). **Conclusion:** The online prevention and control management mode of the NMT team during the COVID-19 epidemic achieved a win-win situation of epidemic prevention and control and promoting the recovery of the children with CHD.

Keywords

NMT, Novel coronavirus infection, Congenital heart disease, Online Management model

1. Introduction

The coronavirus disease 2019 (COVID-19) is a pandemic that has made over 40 million cases and 1.1 million deaths globally as of October 18, 2020 [1]. COVID-19 may be asymptomatic, but most patients have mild to

moderate symptoms [2, 3], and some patients progress rapidly to severe or critical COVID-19 [4]. In those patients, pneumonia, respiratory failure, and death may occur rapidly [4, 5]. Although the majority of symptomatic cases and deaths occur in older adults [2], the median age has been decreasing from May to August in some countries [6]. Nevertheless, all individuals are susceptible to COVID-19 [7-10], and beside older people, other populations susceptible to complications from COVID-19 include any individual with low immunity and comorbidities such as hypertension, diabetes, cardiovascular diseases, which may lead to adverse clinical outcomes and even increased mortality [2, 11-15].

Children with congenital heart disease (CHD) belong to this group. CHD is a group of birth malformation in children, accounting for about 8‰-12‰ of newborn babies [16]. Children with CHD are prone to malnutrition due to the influence of their CHD [17]. Long-term malnutrition increases the hospitalization frequency, surgical risk, and postoperative infection risks, and postoperative wound healing is delayed [18].

Nutrition is considered to play an important role in the comprehensive measures to prevent and treat coronavirus infection [19, 20]. The role of nutrition management in improving nutritional status and immunity, improving clinical outcomes and quality of life, accelerating rehabilitation, and reducing the risk of recurrence should be highly valued, and nutrition management should be incorporated as a basic measure in the whole process of prevention, treatment and rehabilitation of COVID-19 [9].

Children with CHD need regular outpatient follow-up ECG, cardiac ultrasound, nutritional assessment, and even long-term use of diuretics and cardiac stimulants. Children and their family members face a higher risk of SARS-CoV-2 infection and more anxiety than the general public due to repeated visits to the hospitals, which, in itself, is a risk factor for SARS-CoV-2 infection [7, 8, 21]. The Nutritional Management Team (NMT) is a model of multidisciplinary collaboration completed during the COVID-19 epidemic and is designed to provide comprehensive nutritional management to children with CHD. To lower the number of visits to the hospital, the NMT designed an online control management model to give nutritional counseling, intervention, and guidance to children with CHD and their families. The aim of this study is to examine the online control management model designed by the NMT on the well-being of children with CHD during the COVID-19 pandemic.

2. Methods

2.1 Subjects

This study was conducted in the Department of Cardiology of Chengdu Women's and Children's Central Hospital. From February to July 2020, all children with CHD diagnosed by cardiac color Doppler ultrasound were enrolled.

2.2 NMT intervention

Our department has established an NMT team with medical, nursing, nutrition, echocardiography, pharmacy, and psychology cooperation. The organizational structure is shown in Figure 1. The NMT management team is composed of the Division Director and the head nurse of the pediatric cardiology department. The work content and responsibilities include 1) formulate the work responsibilities and procedures of each group, and carry out whole-process control, 2) unify the online training team's about COVID-19 knowledge, continuously update the training materials, and timely organize team members to learn the national, provincial, and municipal COVID-19 prevention and control management norms, 3) nutritional risk screening and nutritional status assessment for patients, 4) develop individualized nutrition management plans for patients with nutritional risk and/or malnutrition and conduct standardized nutritional support treatment, 5) quality control and efficacy monitoring for nutritional support treatment, 6) collect internal opinions in real-time and optimize workflow, 7) nutrition education and follow-up are conducted for the recovered and discharged patients, 8) timely collating popular science materials, combing common questions and answers in epidemic consultation, and developing standardized templates, and 9) coordinate and open the green clinic.

Prevention and control group

The prevention and control group is from the pediatric cardiovascular internal medicine and is composed of two specialist nurses with a work experience of >10 years. A special consultation telephone is set up, and a trained nurse will give telephone consultation to children with CHD who are registered and followed in our department every day. The nurse inquiries about the epidemiological history and clinical symptoms of COVID-19 of the children and their families and recorded the information. Children or family members with epidemiological history and no clinical symptoms will be recorded in the Home Observer Follow-up Form and reported to the online ex-

pert group. Children or family members with epidemiological history and clinical symptoms will be reported to an online expert group for follow-up. The children and their families are guided by the online medical treatment process in the epidemic area of our hospital, and the consultation telephone number is given. COVID-19 gives free consultation to the Department of Children's Cardiovascular Medicine. One aim is to increase the awareness of COVID-19 among children and their families to guide them to conduct correct self-observation and home management.

The information of the children requiring outpatient follow-up visits during the epidemic period is recorded, such as medication adjustment, cardiac color ultrasound, ECG, and other outpatient examinations, in the "Registration Form of follow-up visits for children with congenital heart disease during the epidemic period" and submitted to the online expert group. The group also carries out the outpatient follow-up of children in the epidemic area for disease knowledge, home care, and other health education. The information of the children who need special guidance on medication is recorded in the "Registration Form of medication consultation for children with congenital heart disease during the epidemic period" and reported to the pharmacist group. In the process of counseling, if the nervous and anxious family members fail to achieve good results after psychological comfort, their information is recorded in the "Registration Form of psychological Counseling for family members of children with congenital heart disease during the epidemic period" and reported to the psychological intervention group.

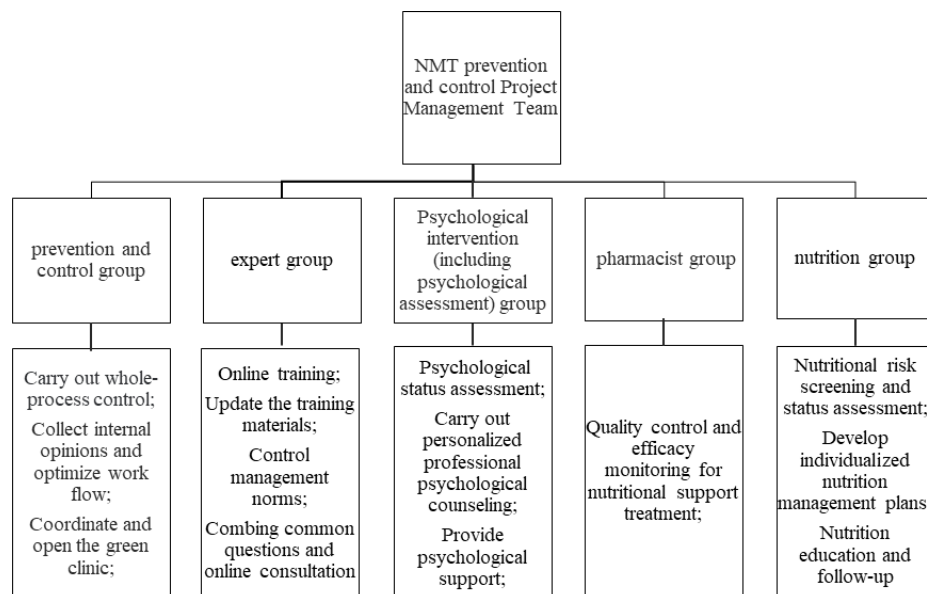


Figure 1. The organizational structure of the Nutritional Management Team.

Online expert group

The online expert group consists of three pediatric cardiologists (two associate chief physicians and one chief physician). The family members of the sick child can consult with the online expert group of pediatric cardiovascular Medicine through the hospital's Internet platform. Without leaving their home, they can obtain the prevention and treatment knowledge of COVID-19, professional guidance for home prevention and control, and diagnosis and treatment of common childhood diseases. The online expert group takes advantage of its own fragmented time to consult online. The online expert group conducts online consultation according to the "Registration Form of re-visit of children with congenital heart disease during the epidemic period", communicates with the family members in detail to understand the condition and treatment of the children, makes online diagnosis and treatment, adjusts the medication treatment plan, and carries out disease publicity and education. The children who must be re-visited on-site are registered for an appointment, and the appointment information is reported to the management group. Payments for healthcare are made online.

The online expert group follows home-based observers by telephone once a week according to the "Home-based observer follow-up Table," including the height, weight, temperature, food intake, urine volume, vomiting, activity, and spirit of the children with CHD and conduct home-based observation guidance. The online expert group recommends medical treatment for an online diagnosis of suspected COVID-19 cases. The patients

and their families are conducted to the nearest COVID-19 screening facility for nucleic acid testing. The group guides the children and family to perform self-protection when going out for medical treatment. The telephone follow-ups are recorded.

Psychological intervention group

The psychological intervention group consists of one professional psychological consultant. According to the "Registration of psychological Consultation for family members of children with congenital heart disease during the epidemic period", the psychological intervention group assesses the psychological status of family members of children with CHD by using the self-assessment form of psychological status and carry out personalized professional psychological counseling according to the parents' worry and anxiety once a week. It also carries out science popularization and education, popularizes knowledge, answers doubts, expedites information, and provides psychological support.

Pharmacist group

The pharmacist group is composed of one professional clinical pharmacist who provides telephone counseling according to the "children with congenital heart disease outbreak period medication consultation registration form" to the families of children two times a week and determines the medical situation according to the illness, drug effects, and side effects.

Nutrition group

The nutrition group is composed of one nutrition professor and one gastroenterologist, who provides nutrition knowledge support to the NMT team and provides personalized nutritional diet guidance to the families of the children during the epidemic period. Nutritional risk screening for children with CHD is performed using a screening tool for the risk of nutritional status and growth (STRONGkids) [22]. The group performs nutritional status assessment (including weight, muscle status, routine hematuria, liver and kidney function, blood lipids, and blood glucose) for children at nutritional risk. According to the assessment results of the nutritional status, the group develops an individual nutritional support treatment plan. The groups performed quality control and effective monitoring of nutritional support treatment, adjustment of the nutritional support treatment regimen, or termination of nutritional support treatment [23, 24]. All long-term follow-up children with CHD are routinely monitored once a week for nutritional status indicators, metabolic indicators, and infection-related indicators, such as body weight, muscle status, hematuria routine, liver, and kidney function, blood lipid and blood glucose, etc. Family nutritional support is provided when necessary.

2.3 NMT model online control closed management

The NMT model is based on the Plan-Do-Check-Action (PDCA) cycle to check each encountered difficulty, collecting and combing problem reports after a unified management group, and form a closed-loop work inspection, to provide rapid response and process optimization. The management team organizes and coordinates to deal with problems and constantly improves the team's overall cooperation ability and sense of cooperation.

2.4 Effect of NMT

Before and 1 week after consultation, the nurses conduct a satisfaction survey on the family members of the sick children using two microcodes of hospital standard satisfaction questionnaire. The satisfaction questionnaire of our hospital is evaluated from five aspects (medical service, nursing service, service attitude, health education, and hospital environment), with a total of 10 items. Each item is scored from 0 to 10 points, with 0 indicating extremely dissatisfied and 10 indicating very satisfied. The satisfaction score is 0-100, with 0 representing extreme dissatisfaction. The higher the score, the better the patient satisfaction.

2.5 Statistical analysis

SPSS 17.0 (SPSS Inc, Chicago, USA) was used for statistical analysis of the data. Continuous data are presented as means \pm standard deviations and were analyzed using Student's t-test. *P*-values <0.05 are considered statistically significant.

3. Results

3.1 The risk of SARS-CoV-2 infection among children and their family members

The NMT team implemented the online prevention and control management in 72 children with CHD (58.3% female; mean age, $1.2 \pm 0.5y$) who were followed for one year since 2019. Eighteen on-site follow-up visits were

canceled. Since one child is accompanied by at least one family member, the cancellation of the on-site follow-up visits in 18 cases avoided the risk of SARS-CoV-2 exposure in at least 36 individuals (Table 1). The green clinic was opened for 10 children who could not cancel the follow-up visits, and seamless patient management was implemented to improve the medical treatment efficiency, reduce the waiting time, and reduce the risk of nosocomial infection.

Table 1. Characteristics of the patients with CHD

Characteristics	N=72
Age, years (mean \pm SD)	1.2 \pm 0.5
Sex (Female/male)	42/30
Online consultation, n (%)	18 (25.0%)
On-site visit, n (%)	54 (75.0%)
Green channel	10 (18.5%)
Other	44 (81.5%)

3.2 Standardization of the long-term management of children

All 72 children were followed by telephone as required by their long-term management. The online expert group provided online assessment, diagnosis, and treatment. Among the 18 cases that canceled their on-site visit, online consultation with the expert group online, online nutritional risk screening, nutritional risk assessment of nutritional status was performed for all 18 children to develop individualized nutritional support treatment and guiding medication and disease. (Table 1) A green channel was opened for 10 children who had to visit on-site to ensure the safety of the treatment. The treatment plan was determined according to the results of ECG, cardiac ultrasound, and nutritional assessment. After the on-site follow-up visit, the patients returned home and were managed as the other children. Four children in the pharmacist group were given medication guidance. During the epidemic period, none of the 72 children suffered from delayed diagnosis and treatment or irregular long-term management due to the influence of the epidemic. This ensured the treatment effect and drug safety of the children during the epidemic period and promoted rehabilitation.

3.3 Psychological care during the epidemic

During this period, psychological interventions were carried out on the families of 11 children, which alleviated or relieved their panic, tension, and anxiety, established a positive attitude, and rationally responded to the epidemic situation.

3.4 Family members' satisfaction

The average satisfaction after the intervention was higher than before the intervention (98.3 \pm 2.8 vs. 95.1 \pm 6.5, $P=0.048$, Table 2).

Table 2. Comparison of the satisfaction of the families of the children before and after the online prevention of the NMT team

	Before intervention(n=72)	After intervention(n=72)	<i>P</i>
Satisfaction (mean \pm SD)	95.1 \pm 6.45	98.3 \pm 2.83	0.048

4. Discussion

Children with CHD require multiple follow-ups at the hospital (including nutritional assessment), increasing the risk of nosocomial infection with the SARS-CoV-2. Therefore, in order to reduce their exposure to possible nosocomial infections, this study aimed to examine the online control management model designed by the NMT on the well-being of children with CHD during the COVID-19 pandemic. The results suggested that the online prevention and control management mode of the NMT team during the COVID-19 epidemic achieved a win-win situation of epidemic prevention and control and promoted the recovery of the children with CHD. It is a new model of high-quality prevention and control service with low risk, low cost, and high efficiency under difficult epidemic situation.

According to the requirements of China's National Health Commission during the pandemic, it is necessary to give full play to the advantages of Internet medical services and vigorously develop Internet diagnosis and treatment services [9]. The outbreak period NMT online control mode combined medical services and the Internet to participate in online epidemic prevention and control, medical, nutrition assessment, psychological counseling, medication guidance, opened the fast-track ("green") channel, and strongly promote the Internet medical consulting services, all of which play an important role in COVID-19 prevention and control and allowing the children with CHD and their families to effectively receive nutritional assessment and professional guidance in time, reduce the personnel gathered together, and effectively reduce the risk of cross-infection to prevent the further spread of the epidemic.

Using this mode, face to face contact is avoided, the risk of SARS-CoV-2 exposure can be reduced, and the safety of children, family members, and medical staff can be effectively protected. On the other hand, it ensures the standard long-term management of children with CHD during the epidemic period, promotes their rehabilitation, and ensures the safety of the children's lives.

The satisfaction degree can be used as an effective means to evaluate medical act quality [25]. The management mode of the NMT's online prevention and control improved the satisfaction of the families of the children with CHD and enabled the medical, nursing, and other professionals to form a multidisciplinary team, which is a new model of providing high-quality epidemic prevention and control services integrating medical treatment, nursing, nutrition, psychology and pharmacy for the families of the children.

The advantages of this model are a small capital investment, relies on the hospital network platform, carries out the prevention and control work by means of online/telephone consultation and informatization, and has strong operability. Nevertheless, there are limitations to this study. It was carried out at a single hospital and in a small group of active patients. Therefore, the exportability and generalizability of the model are unknown. In addition, it is possible that compliance is lower after the online consultation, but there is no means to evaluate this.

5. Conclusion

Nutrition management plays an important role in the long-term follow-up of children with congenital heart disease. The establishment of an NMT and the implementation of the NMT management mode of online control online for children with CHD effectively reduced the risk of exposure to SARS-CoV-2 of children and their families, without decreasing the services offered to the patients and their family. This new model is a win-win scenario and has low risk, low cost, and high efficiency for high-quality services in the context of the COVID-19 epidemic.

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Competing interests

All authors declare that they have no competing interests.

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