Specialist Nurse-Led Environmental Nosocomial Infection-Control Practices in a Pediatric Fever Clinic During the Covid-19 Pandemic

Fanghua Qin, Jianhui Xie, Yinan Liao, Qingqing Song, Yi Xu, Lihui Zhu*

Background: *Fever is one of the commonest symptoms in children, and accounts for one third of the common symptoms of childhood diseases. Most cases of pediatric fever are related to viral infection, especially during the COVID-19 pandemic. This before-and-after study aimed to develop a specialist nurse-led environmental nosocomial infection-control practice, and to evaluate the effect of this practice in a pediatric fever clinic.*

Methods*: Participants were the staff of a fever clinic in a tertiary children's hospital in China. Nosocomial infection-prevention and control knowledge, and the quality of nosocomial infection prevention and control in the fever clinic were assessed before (April to August 2021) and after (October 2021 to February 2022) implementation of specialist-nurse-led infection-control practices and compared.*

Results: *The mean nosocomial infection-prevention and control knowledge score of staff working the fever clinic improved significantly from 77.16 ± 13.37 to 93.51 ± 8.43. The quality score improved significantly from 85.70 ± 3.42 to 94.20 ± 2.19.*

Conclusion: *Specialist nurse-led environmental nosocomial infection-control practice can effectively improve staff knowledge and the quality of nosocomial infection prevention and control in pediatric fever clinics.*

Practice Implications: *The intervention improved staff knowledge of nosocomial infection prevention and control practices, and improved the quality of nosocomial infection prevention and control in a fever clinic. This intervention not only meets the requirements of nosocomial infection management during the COVID-19 pandemic, but also maximizes the utilization of specialist infection control nurses. This management strategy is feasible, effective, and should be promoted in clinical practice.*

Background

The fever clinic is a clinical department where fever patients are diagnosed and treated and is a key sector for nosocomial infection prevention and control. Following the coronavirus disease (COVID-19) outbreak, the National Health Commission of China issued regulations and revised regulations many times. These regulations mandated the standardized management of fever clinics via strategies, such as pre-examination and triage, SARS-CoV-2 nucleic acid testing, fever patient registration, infectious disease reporting, screening, fever patient guidance, and isolation in fever clinics, to identify patients with suspected infectious diseases and to treat patients with fever. Fever is one of the commonest symptoms in children, and accounts for one third of the common symptoms of childhood diseases.[2] Most cases of pediatric fever were related to viral infection,[12] especially during the COVID-19 pandemic. Although the number of confirmed pediatric COVID-19 cases is less than that of adult COVID-19 cases, pediatric patients should not be ignored. In addition, due to the characteristics of the pediatric population, during seasonal variations that induce a high incidence of childhood respiratory diseases,

Hunan Children's Hospital.
Address for correspondence to: Lihui Zhu, Hunan Children's Hospital, 86 Ziyuan Rd, Yuhua District, Changsha, Changsha, Hunan, China, 410021 (45765791@qq.com)

Financial Disclosures: This study was supported by the 2020 Huxiang Youth Talent Support Plan and Hunan Provincial Department of Finance, grant number 2069995050230299.

the number of children with fever increases. Children are often accompanied by many family members when they visit a doctor, and pediatric fever clinics usually have obvious crowds that are more difficult to manage than those in adult hospitals.[3,9] Furthermore, the need for social distancing and patients' fear of infection from healthcare facilities during the COVID-19 pandemic necessitates the use of stricter nosocomial infection-control strategies. Environmental management clearly defines the management scope based on a spatial boundary,[4] and specialist nurse-led environmental nosocomial infection-control practice ensures that each department of the fever clinic, including the pharmacy, laboratory, finance department, cleaning department, etc., is managed by infection-control specialist nurses. In the People's Republic of China, environmental nosocomial infection-control practice is not a popular practice mode of nosocomial infection control owing to the physician's time constraints.

We proposed a specialist nurse-led environmental management plan to ensure the implementation of nosocomial infection-control practices in a pediatric fever clinic during a pandemic against the background of a constrained healthcare delivery system. This study evaluated the implementation of specialist nurse-led environmental nosocomial infection-control practices in a pediatric fever clinic during the COVID-19 pandemic in China and assessed the impact of this intervention on the staff's knowledge and the quality of nosocomial infection prevention and control in the fever clinic.

MATERIALS AND METHODS

Study setting and population

This study was conducted in the fever clinic of a children's hospital in the People's Republic of China from April 2021 to February 2022. The pediatric fever clinic is situated in an area measuring approximately 1,000 m2 and includes five consultation rooms and ten observation rooms. Approximately 400 fever patients are treated every day, and nearly 1,000 people visit the clinics daily. All 74 staff members (16 physicians, 30 nurses, 6 pharmacists, 6 laboratory technicians, 6 financial staff, and 10 cleaning staff) at the fever clinic voluntarily provided written informed consent for study participation. The demographic characteristics of the participants are listed in Table 1. Before the implementation of the intervention, from April to August 2021, we adopted routine nosocomial infection-control practices; thereafter, from October 2021 to February 2022, we adopted a specialist nurse-led environmental management for implementing nosocomial infection-control practices.

Establishing specialist nurse-led environmental nosocomial infection-control practices

Nursing staff play an important role in the management of nosocomial infection control.[13] Our hospital has always attached great importance to the training of nurses on knowledge and skills related to nosocomial infection, especially after the outbreak of COVID-19. The fever clinic is a key department for infection control in the hospital, and the infection-control specialist nurses conduct monthly special training sessions on nosocomial infection that includes both theoretical and skills training. The theoretical content includes basic knowledge of nosocomial infection, transmission processes of infectious diseases, principles of prevention and control, and knowledge related to COVID-19. Skills training includes the selection and use of protective equipment, emergency plan for hospital infection disposal, use and configuration of disinfectant, and disposal of medical waste. The infection-control specialist nurses are responsible for both clinical care and the supervision of nosocomial infection-control practices, education of other hospital staff on nosocomial infection, supervision and guidance of the proper disposal of medical waste, and the provision of health education consultation for families of children with infectious diseases. This forms a basis for specialist nurse-led environmental nosocomial infection-control practices in fever clinics. The purpose of specialist nurse-led environmental nosocomial infection-control practices is to ensure patient safety, implement preventive and control strategies for various groups of people in fever clinics, and ensure the quality of hospital infection-prevention

Table 1

Participant Characteristics

Professional category	Total	Sex		Age, years	Work experience, years	Education level			
		Male	Female	(mean±SD)	(mean±SD)	Middle school	High school	Bachelor's degree	Master's degree
Physician	16	9	7	37.0 ± 6.6	15.0 ± 6.6	0	0	9	7
Nurse	30	0	30	30.6 ± 5.3	9.3 ± 4.8	0	0	29	1
Pharmacists	6	1	5	28.0 ± 4.9	6.7 ± 4.4	0	0	5	1
Laboratory technician	6	2	4	26.2 ± 8.3	4.8 ± 7.9	0	0	2	4
Financial staff	6	0	6	27.3 ± 6.0	5.8 ± 5.4	0	0	6	0
Cleaning staff	10	6	4	59.3 ± 4.0	4.5 ± 1.4	9	1	0	0

and control measures.

Emphasis on standard precautions

The specialist nurse team formulates the practice content based on the actual situation in the environment as follows:

(1) Personnel management: According to the hospital infection-management norms and the latest COVID-19 epidemic prevention and control protocols in their jurisdiction, specialist nurses clarify the protection principles for staff in different positions in various medical departments of the fever clinic. They create the environmental management supervision form and undertake daily full-coverage supervision of the staff at the fever clinic; implement standard protection, health monitoring, and nucleic acid detection for high-risk individuals. Problems identified during the supervision are to be rectified immediately, and the specialist nurse records the problems and submits a report to the head of each department.

(2) Environmental management: The team formulates the daily environmental checklist, which includes an assessment of whether the disinfection is effective, whether the facilities and equipment can be used normally, whether the protective materials are sufficient, whether the garbage disposal is being done correctly, and whether the fever clinic is ventilated regularly. Monitoring of disinfection of surfaces and environments in different parts of the fever clinic is also conducted.

(3) Process management: The nurse-led team creates a process-quality supervision form, and the nurse selects one staff member from different professional roles every day to check whether the work process is correct, for example, epidemiological history investigation, hand hygiene compliance during surgery, medical waste disposal processes, etc. If the nurse finds a problem during the supervision, she asks the individual to immediately rectify the issue and makes a note for follow-up.

(4) Knowledge and skills-based continuous training: The team sets up weekly key working days on which the specialist nurses will conduct weekly training of staff on knowledge and skills for countering nosocomial infection, which is followed by assessment to ascertain successful training and skill mastery.

Intervention method

From April to August 2021, we adopted routine nosocomial infection-control practices. The head of each department at the fever clinic is responsible for the knowledge training and skill training on nosocomial infection of the staff of each department. The hospital department of nosocomial Infection Control Center undertakes irregular supervision at the hospital level. If the supervisor identifies any problem, the department head is required to rectify the problem. From October 2021 to February 2022, we adopted specialist nurse-led environmental nosocomial infection-control practices. First, we integrated environmental resources and information provision in all departments of the fever clinic under the unified jurisdiction of the fever clinic and authorized the infection-control specialist nurses in the fever clinic to establish a work-based WeChat group that included all staff of the fever clinic for unified management and to facilitate information transmission. all fever clinic staff were trained subsequently under the specific supervision scheme as follows: Arrange a specialist nurse to supervise the quality of nosocomial in the fever clinic every day, fill in the supervision form, and immediately rectify the identified issue by providing feedback. As the team leader, the head nurse of fever clinic conducts spot checks, supervision, weekly evaluation of the implementation of the scheme by the team, and organization of weekly specialist nurse team meetings. In the group discussion, the infection-control specialist nurse takes the leading role and analyzes the root cause of the problems identified during the supervision, proposes corrective measures, and dynamically adjusts the focus of work according to the progress of the hospital's overall epidemic prevention and control work. The infection-control specialist nurses summarize the special or common problems, strengthen and refresh staff recall of theoretical training content, and improve the self- management ability. On specific workdays, the infection-control specialist nurses conduct special-person training for the correction of frequently occurring problems. The head nurse can coordinate with various departments to upgrade the process and to revise the system to ensure that the nosocomial infection-management strategy is improved continuously.

Furthermore, infection-control specialist nurses are accountable based on the principle of "who is in charge, who is responsible" for environmental management, and consider the specific behaviors of staff in different positions to accurately and effectively adopt response strategies. Infection-control specialist nurses record the minutes of the special meeting on the rectification goals and formulation of measures.

Data collection and measurements

The staff who work in different positions at the fever clinic all take up the knowledge test on nosocomial infection prevention and control, and the scores are recorded. The test adopts the content of the training evaluation question bank in the app of the hospital's sensory control workshop. The 20 test questions are randomly selected, and each question is assigned 5 points, and the test has a total score of 100 points. The test is conducted online by the hospital department of nosocomial Infection Control Center at the end of each month. The special quality evaluation of nosocomial infection prevention and control in the fever clinic is carried out by the hospital department of nosocomial Infection Control Center. The evaluation tool that is used is the "Special Supervision Form for Nosocomial Infection Prevention and Control," which is formulated by the Hospital Quality Management Committee. This form is an upgrade of the inspection content. The original content of the nosocomial infection prevention and control is updated according to the latest standardized prevention and control protocols for COVID-19. The content covers 31 detailed rules in five parts, including personnel protection, operation procedures, disinfection and disposal, sterile material management, and record filing. The evaluation form has been discussed and revised by experts from the hospital's quality management committee. Each detailed rule is assigned 2–5 and the test has a total score of 100 points. The hospital department of nosocomial Infection Control Center will conduct weekly onsite supervision and evaluation.

Statistical Analysis

We used SPSS Statistics V.25.0 for Windows for data analysis. The measurement data are expressed as mean ± SD. Intergroup comparison was performed with the t-test. The difference between two variables was considered significant if the two-sided P-value was less than 0.05.

RESULTS

Among the 74 staff participants from the pediatric fever clinic, the results showed that the knowledge of nosocomial infection prevention and control of all staff has been significantly improved following the intervention. The score of nosocomial infection prevention and control knowledge of staff in different positions at the fever clinic increased from 77.16 ± 13.372 before the implementation to 93.51 ± 8.429 after implementation (Table 2). The weekly evaluation of the quality of nosocomial infection prevention and control in fever clinics by the hospital department of nosocomial Infection Control Center showed that the quality had improved. The quality score of nosocomial infection prevention and control in the fever clinic improved from 85.70 ± 3.420 before the implementation to 94.20 ± 2.191 after the implementation of the intervention. The results showed that there was a statistically significant difference in three variables: operative procedures, infection and disposal, and sterile material management. Therefore, the overall quality of nosocomial infection management in fever clinics improved after the intervention (Table 3).

DISCUSSION

To the best of our knowledge, this is the first study to demonstrate that specialist nurse-led environmental nosocomial infection-control practices can successfully improve the knowledge of hospital staff on nosocomial infection prevention and control and the quality of fever clinic management during the COVID-19 pandemic, which imposed several challenges during nosocomial infection management. Stringent nosocomial infection-prevention and control measures are needed to avoid nosocomial infections. As the first checkpoint for screening infectious diseases, fever clinics mainly screen fever patients for COVID-19, and bear a major responsibility in epidemic prevention.[14] Despite huge advances in vaccination, childhood infectious diseases still feature prominently in global public health.[10] Most of the infectious diseases have fever as a symptom,[7] and pediatric patients often involve multiple family members who accompany them. In case of deficiencies in nosocomial infection management, nosocomial virus transmission occurs easily and can threaten the lives of children, their families, and hospital staff, especially in a populous country such as China.[6] In this study, owing to the time constraints of physicians, we were able to rapidly create a team of nursing staff to conduct environmental management of nosocomial infection-control practices in a pediatric fever clinic. Environmental management integrates departmental resources, facilitates effective information transmission,[11] refines job responsibilities, improves precise management, and fine-tunes control processes, clarifies accountability risks, and makes management practices efficient and more scientific. Furthermore, specialist nurses have sufficient decision-making power and supervisory capacity, and can directly implement nosocomial infection supervision and training for staff in multiple positions, thereby disrupting the conventional nosocomial infection-management practice model. The ability and role of specialist nurses are fully reflected. Table 2 shows that, before the implementation of specialist nurse-led environmental nosocomial infection-control practices, the knowledge level of nosocomial infection prevention and control among the fever clinic staff was relatively low (77.16±13.372). Pharmacists, financial staff, and cleaning staff had less knowledge of nosocomial infection prevention and control than doctors and nurses. The score of the cleaning staff was the lowest (56.50±5.798).). In hospitals, pharmacists and financial staff are paramedical staff who are not directly involved in clinical work and believe that they do not have direct contact with patients, and, therefore, their risk of infection is low; thus, it is

Table2:

Assessment scores of nosocomial infection prevention and control knowledge of staff in different professional categories

Category	N	Pre-intervention score (mean ± SD)	Post-intervention score (mean ±SD)	*t*	P
Physician	16	80.63 ± 5.12	97.50 ± 3.65	−10.729	<0.001
Nurse	30	87.33 ± 8.17	98.67 ± 2.25	−7.324	<0.001
Laboratory technician	6	78.33 ± 5.16	92.50 ± 6.12	−4.332	0.001
Pharmacist	6	63.33 ± 9.83	86.67 ± 10.33	−4.008	0.002
Financial staff	6	64.17 ± 3.76	89.17 ± 5.85	−8.808	<0.001
Cleaning staff	10	56.50 ± 5.80	79.00 ± 6.58	−8.111	<0.001
All participants	74	77.16 ± 13.37	93.51 ± 8.43	−8.898	<0.001

easy to ignore the risk of nosocomial infection. In fact, at the clinic, the staff of the medical departments need to have contact with the family members of the patient, which also confers a risk of nosocomial infection. Cleaning staff are responsible for the environmental cleaning, disinfection, and garbage disposal for the whole medical unit. The lack of nosocomial infection-control knowledge of cleaning staff is an important factor in the occurrence of nosocomial infection.[5] As in most health facilities in China, considering the education level of the staff, cleaning staff are less educated than other medical staff. Some studies have shown that cleaning staff have insufficient knowledge of nosocomial infections and low compliance with hand hygiene practices.[1] If cleaning staff are not trained in nosocomial infection knowledge, they can easily facilitate virus transmission. Especially during the pandemic, medical institutions should strengthen the training of the knowledge and skills of cleaning staff on nosocomial infection prevention and control.[18] In this study, the specialist nurse formulates the content of the plan according to the target principle, and conducts inspection and supervision according to the predefined standards. In the practice process, specialist nurses can identify knowledge insufficiencies and targeted training measures can be undertaken to improve the knowledge level of nosocomial infection prevention and control of staff in different positions in the fever clinic. Continuous follow-up and supervision have made the staff pay more attention to the prevention and control of nosocomial infection, promoted the staff to consciously learn relevant knowledge, strengthened their awareness of self-management, and thus improved their knowledge level.[17] Specialist nurse-led environmental nosocomial infection-control practices can effectively improve the staff's knowledge of nosocomial infection prevention and control in fever clinics. Fever clinics have multiple departments and many staff. If nosocomial infection management only targets a certain department, it cannot be sustained and effective, and cannot effectively improve the quality of nosocomial infection prevention and control in fever clinics. Studies have shown that the efficiency and quality of nosocomial infection prevention and control management are related to the department's active self-examination and continuous improvement capabilities.[15] Specialist nurse-led environmental nosocomial infection-control practices emphasize integrated management. In the process of practice, all departments in the unit are included in the management scope, and the problems in clinical work are fed back and tracked continuously at any time. The management of nosocomial infection is fully delegated to specialist nurses, to ensure the successful implementation of this management strategy. Based on long-term clinical practice, infection-control specialist nurses have

Table 3:
The quality score of nosocomial infection prevention and control in the fever clinic

Subcategory	Pre-intervention score (N = 20) (mean ± SD)	Post-intervention score (N = 20) (mean ± SD)	*t*	*P*
Frequency	20	20		
Personnel protection (10)	8.00 ± 3.40	9.25 ± 1.83	−1.447	0.156
Operation procedures (36)	31.10 ± 3.73	34.15 ± 2.03	−3.213	0.003
Disinfection and disposal (24)	19.70 ± 2.92	21.65 ± 2.48	−2.277	0.029
Sterile material management (22)	19.50 ± 2.89	21.35 ± 1.23	−2.633	0.012
Record filing (8)	7.20 ± 1.64	7.80 ± 0.89	−1.435	0.159
Total	85.70 ± 3.42	94.20 ± 2.19	−9.36	<0.001

accumulated strong professional capability, excellent nursing leadership, specialized nurses have strong executive ability and high team cohesion.[16] Such characteristics made this study feasible. Infection-control specialist nurses have a good theoretical and practical foundation for the prevention and control of infectious diseases and the implementation of nosocomial infection-control measures. In management practices, infection-control specialist nurses have good compliance. Through standardized management, inspection and feedback, improvement and implementation, and continuous tracking, problems that are identified can be corrected immediately, and the management effect can be continuously strengthened to form a virtuous circle of management to improve the quality of nosocomial infection prevention and control in fever clinics. Table 3 shows improvements in the special quality of the operation procedures, disinfection and disposal, and sterile material management as well as the overall quality score of nosocomial infection prevention and control after the implementation of specialist nurse-led environmental nosocomial infection-control practices. This therefore effectively improves the quality of nosocomial infection prevention and control in fever clinics.

CONCLUSIONS

Due to the unique characteristics of pediatric fever clinic, the nosocomial infection prevention and control management of children and accompanying family members at such clinics is difficult, especially during the pandemic. In such cases, a specialist nurse-led environmental management was conducted for nosocomial infection-control practices and could effectively improve the staff's knowledge of nosocomial infection prevention and control, and improve the quality of nosocomial infection prevention and control in fever clinics. This will not only meet the requirements of nosocomial infection management during the pandemic but also maximizes the utilization of infection-specialist nurses[8] The management strategy is determined to be feasible, effective, and worthy of promotion. A major limitation of this study is that we investigated the improvement of knowledge of the staff and quality of nosocomial infection prevention of only the pediatric fever clinic. In the future, the impact of this management strategy on aspects such as patient safety and the competence of specialist nurses should be explored.

REFERENCES

1.Caixue L, Bin W, Shimin H, et al. A survey of hand hygiene compliance of cleaning staff in a hospital.Chinese Journal of Disinfection2015;32:1131–1132.

2.Chiappini E, Bortone B, Galli L, et al. Guidelines for the symptomatic management of fever in children: systematic review of the literature and quality appraisal with AGREE II.BMJ Open 2017;7:e015404.

3.Cui X, Zhang T, Zheng J, et al. Children with coronavirus disease 2019: a review of demographic, clinical, laboratory, and imaging features in pediatric patients.J Med Virol 2020; 92:1501-1510.

4.Hong W, Bin L. Emergency decision-making dilemma in territorial management of emergencies: based on major infectious disease events. Journal of Guangxi Normal University (Philosophy & Social Sciences Edition) 2022;1–11

5.Hongjuan Z, Shujun W, Xu L, et al. Effects of hand hygiene compliance training for cleaning staff on infection control in burn intensive care units. Chinese Journal of Modern Nursing 2016; 22:1935–1938.

6.Hui C, Huaiwu J, Jingmei L. Strategies for district-level admissions of fever clinics in designated hospitals for infectious diseases during the outbreak of COVID-19.Parasites and Infectious Diseases 2020;18:141–144.

7.Lu L, Chu L, Wu H, et al. Establishment of pre-examination and triage management system for fever patients and evaluation of application effect of standardized workflow.China Journal of Critical Care Medicine (electronic version) 2021;14:497–499.

8.Mayo AM, Ray MM, Chamblee TB, et al. The advanced practice clinical nurse specialist.Nurs Adm Q 2017;41:70-76.

9.Mingxia S, Haiyan H, Mingyue H, et al. Establishment and implementation of emergency treatment mechanism for fever clinic in children 's hospital during the outbreak of COVID-19. Journal of Nursing Management 2020;20:268–272.

10.Procianoy RS. Current focus on infectious diseases in childhood.J Pediatr (Rio J) 2020;96 Suppl 1(Suppl 1):1.

11.Qi J. On the "territorial management principle" of public health emergencies.Contemporary Law 2020;34:37–46.

12.Qi W, Shaoyu S, Lamei L, et al. Interpretation and content analysis of clinical practice guidelines for fever management in children.Nursing Journal 2021;36:28–31.

13.Quwen L, Linping S. Current situation and enlightenment of infection management specialist nurse training in Japan.Nursing Research 2018;32:2012–2014.

14.Rong F, Hui C, Chunlei C, et al. Management of suspected cases of coronavirus patients in children's hospital fever clinic.Modern Hospital 2020;20:1438–1445.

15.Wenhui M, LihongW, Jingli Z, et al. Establishment and practice of a grid system for prevention and control of nosocomial infections.Chinese Journal of Hospital Infections 2021;31:2846–2849.

16.Wu X, Wang Y, Liu H. Reflections on the value of nursing profession during the COVID-19 pandemic.China Nursing Management 2021;21:641–645.

17.Xinping A, Chuanhui H, Guoqiong G, et al. Full-time nosocomial infection management staff follow-up supervision to improve the quality of nosocomial infection management in CT room.Journal of Nursing 2015;30:84–88.

18.Xuejun L, Xuewu J, Zhangui F, et al. Investigation and management countermeasure analysis of nosocomial infection control of cleaning staff in a hospital.China Health Standard Management 2021;12:124–127.