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ORIGINAL RESEARCH

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Preisolation measures and clinical features for pediatric patients with suspicious COVID-19

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Abstract

Background: In December 2019, many cases of COVID-19 were reported in Wuhan City, Hubei Province, China. In the following 3 months, the disease out broke in China. Preisolation measures was used to screen out COVID-19 patients in the pediatric respiratory ward of our hospital.

Aims: To investigate the new measures for screening COVID-19 patients and to analyze the clinical features of children with suspicious COVID-19.

Methods: A total of 50 preisolated children with suspicious COVID-19 who were admitted to our hospital in Mianyang, China, between January 28 and March 5, 2020, were included. Patients presented with fever and cough or fever accompanied by vomiting and diarrhea. A detailed epidemiological history screening was performed. A real-time reverse-transcriptase–polymerase-chain-reaction (RT-PCR) was used to detect SARS-COV-2 nucleic acid. Low-dose chest computed tomography (CT) was applied when pneumonia was suspicious. Routine blood tests were performed to rule out COVID-19. Patients' data were collected, and the basic clinical features, epidemiological history, clinical manifestations, auxiliary examination results, and outcomes were analyzed and summarized.

Results: No definite cases were detected, while two patients were suspected of having COVID-19. The pathogenic results of the 50 patients mainly included *Mycoplasma pneumoniae*, followed by Epstein–Barr virus, and rotavirus. Thirty-five patients suffered from bronchopneumonia. The preisolated patients had similar clinical and epidemiological characteristics as patients with fever, cough, vomiting, and diarrhea.

Conclusions: Preisolation measures combined with pathogen screening can minimize the risk of hospital-acquired infections by preventing patients with suspicious COVID-19 from contacting other patients before they are explicitly excluded. Clinical analysis of the patients was helpful for clinical nursing management.

KEYWORDS

clinical characteristics, COVID-19, infection control, outcomes, pediatric, precautions, preisolation

Xiaoyu Li, Fengqiong Jiang, and Yun Qiu are co-first authors.

1 | BACKGROUND

COVID-19 is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which appeared in December 2019 in Wuhan City, Hubei Province, China.[1] COVID-19 is a class B infectious disease, treated as a Class A infectious disease. According to the World Health Organization, more than 514 million cases have been reported worldwide, causing more than 6 million deaths. Infections have been mainly reported in adults and the elderly population, while only a few cases were reported in children, none of which were serious. A similar situation was observed during the Middle East respiratory syndrome (MERS) outbreaks.[2]

With reference to COVID-19, cases affecting children in China were successively reported in Shenzhen, Shanxi, and Beijing. On January 26, 2020, a 5-year-old infected child was admitted to our hospital. He presented with a cough that lasted 4 days and a transient low fever (37.8°C) on the day of the onset. Lower left pneumonia was diagnosed at admission. However, a few hours after hospitalization, we received a call from the local government informing us that the patient came in contact with a COVID-19 patient on January 22. Immediately, he was transferred to the infectious department for isolation, observation, and treatment. Subsequently, everyone who came in contact with the child was isolated.

Preisolation measures are important to prevent cross-infection of patients with suspicious infectious diseases in the ward. These patients are with clinical manifestations related to infectious diseases or have a history of contact with patients with infectious diseases. Preisolation measures are applied until suspicious patients are confirmed as healthy, that is, not affected by infectious disease. The diagnosis and treatment of preisolated children were carried out according to the standard of diagnosis and treatment. Preisolation has already been applied in the past to prevent hospital infection of MERS coronavirus (MERS-CoV).[3]

Given the above emergency events and epidemiological characteristics of children, our ward launched the preisolation system on January 28, 2020. In this study, we analyzed the clinical features of children with suspicious COVID-19 who were subjected to preisolation measures to establish effective protocols for excluding patients with COVID-19 from the pediatric respiratory ward. From January 28 to March 5, 2020, 50 patients suspicious of COVID were preisolated. Twenty-six patients were male, 24 were female; their age ranged between 1 and 137 months. They had clinical manifestations indicative of COVID-19 or contact history.

2 | METHODS

2.1 | Patients and preisolation

From January 28 to March 5, 2020, 50 patients suspicious of COVID (as the following inclusion criteria) admitted to the pediatric respiratory ward were preisolated in a single room in one separate area. Inclusion criteria were the following: ① those who met the indications for hospitalization; ② those with unclear epidemiological history who could not be completely excluded; ③ patients who met any of the following clinical manifestations: fever with respiratory symptoms or lung imaging changes; fever with nausea, vomiting and diarrhea, fatigue; fever with normal or decreased white blood cell counts and decreased lymphocyte counts. Exclusion criteria were: ① at the time of admission, two consecutive negative nucleic acid tests for the new coronavirus (24 h apart); ② cases with no epidemiological history and no new crown-related clinical manifestations.

A detailed epidemiological history screening was performed. In addition, a real-time reverse-transcriptase–polymerase-chain-reaction (RT-PCR) was used to detect SARS-COV-2 nucleic acid. Low-dose chest computed tomography (CT) was applied when pneumonia was suspicious. Also, routine blood tests were conducted to rule out COVID-19. The diagnosis and treatment of the patients were carried out using routine methods. The diagnosis was based on epidemiological history, clinical manifestations, laboratory tests, and auxiliary tests. Treatment included anti-infective, antipyretic, expectorant, cough relief, rehydration, and so forth. We also collected and analyzed the patients' data to observe the effect of nosocomial infection control and the clinical features of the patients.

Preisolation was considered concluded if two consecutive negative nucleic acid tests for the new coronavirus (24 h apart) appeared and no clear epidemiological history after re-examination was seen.

An isolated section with independent aisles and exits in the ward was selected. The area had three entrances and seven single wards as a preisolation area. A screen was used to block off the exit leading from this zone to the public area. Also, signs warning of Contact, Droplet, and Respiratory Isolation were put up. Separate entrances were designated for patients and medical staff.

2.2 | Observation metrics

The patients' data were collected; observation metrics were the following: ① basic clinical features; ② epidemiological history; ③ clinical manifestations; ④ auxiliary examination results; ⑤ outcomes.

2.3 | Preisolation management measures

2.3.1 | Nursing human resource deployment and management

① All interns were instructed to extend their vacation and temporarily stay at home. ② Senior technical nurses were in charge of managing the preisolation patients. They all received COVID-19 training (how to deal with patients and prevent further infection). ③ A nurse was assigned to work in full-time epidemic investigation every day. ④ We also paid attention to the psychological well-being of the nurses.

2.3.2 | Cleaning crew management

Two experienced members of the cleaning crew were responsible for disinfection. They underwent training that included personal protection, disinfection methods, and hospital infection control management systems and procedures. The two members of the cleaning crew took turns on duty. We also paid attention to their psychological status and ensured proper management and accessibility to knowledge related to disease-related protection. We also sought to reduce fear and anxiety.

2.3.3 | Patients and guardians management

Each patient was allowed one guardian, and the ward doors were kept closed. Patients and guardians were required to stay at the ward wearing masks and use only the designated entrance to go in and out of the ward. When a chest CT was needed, the responsible nurse would contact the radiology staff in advance. Under the guidance of the responsible nurse, patients and guardians were required to wear masks when leaving the radiology department. The remaining nonemergency examinations were completed after COVID-19 was excluded. Meanwhile, we paid attention to the psychological status of patients and their guardians. They were given information on the corresponding process and management system of COVID-19.

2.3.4 | Hospital infection management

Personal protection, disinfection, isolation, and management of medical waste were carried out in accordance with the prevention and control plan for new coronavirus pneumonia (second version) by the National Health Commission. All the medical measures were carried out following the three-level protection measures.

2.4 | Statistical analysis

Categorical variables were described as frequency rates and percentages, and continuous variables were described using mean, median, and interquartile range (IQR) values. All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences) version 22.0 software.

2.5 | Ethical consideration

This study only analyzed the patient's medical records, there is no risk to the patients' health, and informed consent has been applied for exemption.

3 | RESULTS

3.1 | Screening results

A total of 50 preisolated patients were included between January 28 and March 5, 2020. No confirmed cases were detected. There were two (4%) patients who were transferred to a designated hospital due to COVID-19 exposure and family clustering, and four (8%) patients who had suspicious contact with Hubei or confirmed patients, due to which they were isolated until discharged. Twelve individuals (24%) infected with EB or rotaviruses were transferred to infectious rooms. In addition, 32 patients were transferred to the general rooms. No medical staff or patients had hospital infections.

3.2 | The clinical and epidemiological characteristics

The clinical and epidemiological characteristics of the 50 preisolated patients are shown in Table 1. Thirty-five (70%) patients had bronchopneumonia and a history of suspicious exposure. Forty-one (82%) patients were not from Hubei, while nine patients had a history of sojourn in Hubei. One patient had a history of cluster onset, and one was with a history of exposure to COVID-19.

3.3 | The clinical manifestations and auxiliary examination results

Among 40 (80%) children with fever, 36 (72%) had a fever that lasted <3 days, and 4 (8%) had a fever that lasted >3 days (resolved within 7 days). In addition, 37 (74%) children had a cough. Also, 36 (72%) children were admitted to the hospital with changes in chest X-ray/CT, which were exudative in most patients. Fifty children were tested for nucleic acid, all with negative results. Additionally, 35 (70%) tested positive on mycoplasma tests. Five (10%) showed dual infection, *Mycoplasma pneumoniae* combined with EB virus, *M. pneumoniae* combined with rotavirus, and EB virus combined with *Streptococcus pneumonia*. The clinical manifestations and auxiliary examination results are shown in Table 2.

3.4 | Outcomes of the patients

The outcomes of the patients are shown in Table 3. The average length of hospital stay for 50 children was 7 days, and the average number of days of isolation was 2 days. Two (4%) patients who were diagnosed with suspected COVID-19 were transferred to a designated hospital for treatment, yet, they showed negative results for COVID-19 and were discharged after 7 days.

TABLE 1 Clinical and epidemiological characteristics of 50 preisolated patients.

Characteristic	Data	
Gender male/female	26/24	
The median age of months	21.5 (1–137)[a]	
Median oxygen saturation	0.97 (0.95–0.99)[a]	
Admission diagnosis	*N*	%
Bronchopneumonia	35	70
Febrile convulsion (one case with purulent tonsillitis)	7	14
Infectious mononucleosis	4	8
Asthmatic bronchitis	4	8
Epidemiological history within the first half month of onset		
A history of sojourn in Hubei (by train, the high-speed train, the airplane)	9	18
From the community with confirmed cases	0	0
Disease clustering	1	2
Contact history of COVID-19 patients	1	2

[a]Median (range).

TABLE 2 Clinical manifestations and auxiliary examination results of 50 preisolated patients.

Symptom	*N*	%
Cough	37 (dry cough22/wet cough15)	74
Fever	40 (high fever17/low to medium fever23)	80
Asthma	5	10
Vomiting	3	6
Abnormal WBC count	5 (high4/low1)	10
Abnormal lymphocyte count	22 (high19/low3)	44
Abnormal chest X-ray/CT	36 (exuded 19/patchy film4/ consolidation change 9/ground glass shadow 6/pulmonary enhancement 5)	72
Etiological examination		
Mycoplasma pneumoniae	35	70
Epstein Barr Virus	8	16
Rotavirus	4	8
Staphylococcus aureus	4	8
Moraxella catarrhalis	4	8
Positive RT-PCR	0	0

Abbreviations: CT, computed tomography; RT-PCR, reverse-transcriptase–polymerase-chain-reaction.

TABLE 3 Outcomes of 50 preisolated patients.

Item	Median (days)	IQR (days)
Hospitalization days	7	3
Isolation days	2	1
Suspected case detected and transferred to an infectious hospital	2	

4 | DISCUSSION

Preisolation and re-examination of epidemiological history combined with rapid viral nucleic acid detection and low-dose chest CT (when required) could prevent further transmission of COVID-19. In this study, 50 preisolated patients were admitted from January 28 to March 5, 2020. No confirmed COVID-19 cases were detected, while two (4%) patients were transferred to a designated hospital due to COVID-19 exposure and family clustering. After analyzing the basic clinical features, epidemiological history, clinical manifestations, auxiliary examination results, and outcomes, it was discovered that these patients shared clinical and epidemiological characteristics with those having fever and cough, vomiting, and diarrhea. Bronchopneumonia was the main disease, and *M. pneumonia* was the most common pathogen.

When managing preisolated patients, rational deployment of all staff and placement of medical personnel with strong comprehensive ability is the cornerstone of ensuring the quality of hospital infection control. The full-time COVID-19 detection nurse can assist the head nurse in conducting related work and daily monitoring of the hospital infection prevention and control. Moreover, managing patients and guardians is important to control hospital infection.

The National Health and Medical Commission recently established the working principles of a "prevention-oriented combination of prevention and treatment, scientific guidance, and timely treatment" to regulate the work of COVID-19. During the preventive and control work, performing optimal pre-screening and triage work is of utmost importance. However, with the evolution of the epidemic, the epidemiological history of COVID-19 has changed. According to "Novel Coronavirus Pneumonia Prevention/Diagnosis and Treatment Program," the epidemiological history, defined as "a history of travel or residence in Wuhan 14 days before the onset of illness" in the 2nd Version was further updated to "other case-reporting places" in the 3d Trial Version and "contact with patients with fever or respiratory symptoms in the case-reporting community" in the 5th Trial Version, thus challenging the establishment of the history of exposure.

Fever, coughing, vomiting, and diarrhea are common symptoms of many childhood diseases. Children usually have different caregivers (parents, grandparents, and similar), so the statement of contact history may contain omissions, eventually leading to missed information. Preisolation measures can help to minimize the number of missed cases of COVID-19. Patients with suspicious exposure history need to undergo two RT-PCR (24 h intervals) screening to rule

out COVID-19 infection, and they may be informed as a COVID-19 contactor during the pre-isolation period, just like the aforementioned cases. Preisolation measures were used by Bleibtreu et al.[3] in the management of 93 hospitalized patients suspected of MERS coronavirus (MERS-CoV) infection, where 59 cases of pneumonia patients were admitted to neurosurgery during COVID-19 outbreak.[4]

Training ensures strict prevention and zero infection rates. Nurse educators are important in training and providing the necessary details to identify, control, and manage infectious patients. Under the guidance of the head nurse, epidemic-related knowledge, such as that contained in "the Law on the Prevention and Control of Infectious Diseases," "the Emergency Regulations on Public Emergencies," the COVID-19 diagnosis and treatment guidelines, the COVID-19 prevention and control guidelines, epidemiological screening, is included in the training.

Pre-examination triage and ward work systems and processes were also found to be of essential importance. In addition, we made an educational video on how to correctly perform hand hygiene, put on and take off protective equipment, and correctly engage in disposal processes after occupational exposure, cleaning and disinfection measures, throat swab specimens, and so forth. The staff had to follow the video protocol and simulation operation until the assessment was passed. As previously reported, students are reluctant to work in medical institutions without adequate isolation control policies, as shown in the case of MERS infections.[5] Existing studies reported low scores among nursing students regarding related knowledge and preventive behaviors during the MERS outbreak.[6] As the global spread of COVID-19 may have led to a shortage of protective materials, an effective measure for disease prevention and control is minimizing the flow of people. As relevant knowledge of COVID-19 is constantly being updated, it might be quite challenging for interns to keep up. Thus, in this study, no interns were included in the project to reduce the risk of occupational exposure. The rational allocation of human resources is crucial in implementing preisolation measures in hospitals.

Nurses involved in caring for patients with MERS-CoV have reported experiencing stress from fear of infection and heavy workload. Significant differences between the people working in isolation and nonisolation areas were found during MERS-CoV infection.[7] The Saudi Arabian Ministry of Health routinely screened all close contacts of patients diagnosed with MERS-CoV infection. More than 3000 people have been screened, and seven health care workers with MERS-CoV infection were identified.[8] Meanwhile, among the 138 confirmed cases of COVID-19 in a hospital in Wuhan, 40 were medical staff members, accounting for 29% of all cases.[9] Fear of infection, limited understanding of COVID-19, and lack of familiarity with protection knowledge have led to significant psychological pressure on nurses engaged in nursing work related to COVID-19. Therefore, continuous attention must be paid to the psychological well-being of nurses.

During the epidemic period of COVID-19, nurses were the key contributors, and burnout caused by psychological stress was related to the decline in compliance with infection control.[10] Therefore, a full-time COVID-19 detection nurse was assigned to facilitate the management of normal epidemic prevention and control so as to relieve the double pressure brought by clinical work and epidemic prevention and control. The working quality of cleaners is also crucial for effectively preventing and controlling the infection. In this study, the full-time COVID-19 detection nurse was assigned to supervise and guide staff in prevention and control behaviors and investigate all staff members' epidemiologic history and COVID-19-relevant symptoms daily.

The COVID-19 detection nurse monitored the epidemic situation of patients and guardians on a daily basis. Those with symptoms were directed to the "Fever clinic." Nurses also provided psychological support for preisolated patients and their guardians. In the case of individuals isolated due to MERS, anxiety was identified in 7.6% of them, while 16.6% experienced feelings of anger during isolation. Thus, mental health support, accurate information, and appropriate supplies, including food, clothing, and shelter, should be provided to alleviate the psychological distress.[11]

The preisolation patients shared common clinical and epidemiological characteristics of those with fever, cough, vomiting, and diarrhea. Thirty-five (70%) patients had bronchopneumonia, while *M. pneumonia* was the main pathogen (found in 70% of cases), which is not consistent with studies reporting on adult patients.[3] Adult patients suspected of MERS-CoV infection and admitted to an isolation ward in the Paris area in December 2016 were infected with rhinovirus (27.9%) and influenza virus (26.8%). The proportion of *M. pneumoniae* in children patients in this study was higher than that reported before (35%).[12] The negative results of the COVID-19 nucleic acid sampled in this study may be related to the low risk of preisolated patients. All patients in this study were with a negative nucleic acid test; two patients with reduced lymphocyte counts had febrile convulsions, while 72% had abnormal chest detection, mainly exudation. Also, their white blood cell count and other clinical manifestations did not meet the criteria for COVID-19.

Two (4%) suspected cases were screened out during preisolation due to COVID-19 exposure and family clustering and were immediately transferred to the designated hospital for isolation. Four (8%) patients came in contact with Hubei or confirmed patients, so they were isolated until being discharged. Moreover, 12 (24%) cases were infected with EB or rotaviruses and were transferred to infectious rooms, and 32 patients were transferred to general rooms. The preisolation combined with the re-screening of the epidemiological history of COVID-19, viral nucleic acids screening, low-dose chest CT (when required), and other pathogen screening could help detect suspected or confirmed cases of COVID-19 patients, who should then be transferred to the designated hospital. At the same time, screening for other pathogens could also help to detect infected persons, which promotes appropriate infection prevention measures to ensure medical safety, thus avoiding cross-infection.

5 | STUDY LIMITATIONS

The present study has some limitations. It is a single-center retrospective analysis with small sample size. More similar studies are needed to complement and confirm these findings.

6 | CONCLUSIONS

Preisolation measures combined with the re-screening that includes analysis of the epidemiological history of COVID-19, viral nucleic acids screening, low-dose chest CT (when necessary), and other pathogen screening are useful for preventing further COVID-19 transmission. To sum up, the preisolation could help to avoid the risk of hospital infection during the epidemic of COVID-19. In addition, this method could be further applied for preventing and controlling similar infections. Yet, more studies are needed to verify the effect of preisolation in different situations.

7 | IMPLICATIONS FOR NURSING PRACTICE AND POLICY

The application of pre-isolation measures could be helpful in controlling hospital cross-infection during the outbreak of other types of infectious diseases. In addition, the findings of the clinical features could guide the pediatric medical staff in choosing suit therapeutic project.

AUTHOR CONTRIBUTIONS

Xiaoyu Li: Conceptualization; formal analysis; resources; supervision; writing—original draft; writing—review & editing **Fengqiong Jiang**: Data curation; methodology; project administration; writing—review & editing. **Yun Qiu**: Conceptualization; resources. **Jing Yu**: Conceptualization; data curation; resources; supervision y. zhu data curation; formal analysis; investigation; project administration; resources. **Xiaoli Tang**: Data curation; investigation; resources; visualization. **Hongyan Chen**: Data curation; methodology; project administration; supervision. **Tingting Hu**: Data curation; investigation; methodology; resources. **Yinghan Zhao**: Data curation; investigation; methodology; project administration.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data is not available due to ethical restrictions. Due to the nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data is not available. All authors have read and approved the final version of the manuscript (corresponding author or manuscript guarantor) had full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis. The supporting source/financial relationships had no involvement in study design; collection, analysis, and interpretation of data; writing of the report; and the decision to submit the report for publication. The authors confirm that the data supporting the findings of this study are available within the article [and/or] its supplementary materials. The primary data cannot be shared publicly for the patients' privacy.

ETHICS STATEMENT

The ethical committee of Mianyang Central Hospital approved the study (File No: S20220314-02). The researcher endeavored to ensure the participants' privacy: the data did not involve the participants' private details, and a specific person associated with the research was designated to secure the materials.

TRANSPARENCY STATEMENT

The lead author X. Y. Li affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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