

# The importance of education of infection control practices to acute lymphoblastic leukemia patient families for 2019-nCoV prevention

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## Research

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# Abstract

**Background:** With the outbreak of coronavirus disease 2019 (2019-nCoV, also named COVID-19) and growing knowledge of its epidemiological characteristics, it has been clear that children with acute lymphoblastic leukemia (ALL) are also susceptible to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

**Methods:** In the past four months, we educated the guardians of children with leukemia with a series of preventative measures, including ☐ Hand Hygiene and Hand Care; ☐ the use of masks; ☐ separation and sterilization of patient items; ☐ avoiding public transportation; ☐ Staying at home unless medically necessary; ☐ Telemedicine; ☐ Allowing only one caretaker during hospital admission ☐ minimizing patients and their families visiting or travelling. We conducted a retrospective review to study the relationship between compliance with personal preventive measures and exposure to 2019-nCoV among children with ALL and their caretakers before and during the outbreak of 2019-nCoV in China between Jan 21-May 23 of 2020.

**Results:** Prior to the outbreak of coronavirus 2019-nCoV in Jan 2020, 88.9% of patients washed their hands before meals and 55.6% after they ate. All of the patients who are >3 years old and 91% of the patients <3 years olds wore face masks regularly as a strategy for protection in the outdoors. When in the hospital, 95.5% of the patients who are >3 years old and 78% of the patients <3 years olds wore face masks regularly as a strategy for protection. Since the outbreak of coronavirus 2019-nCoV in China in Jan, 2020, the percentage of compliance to hand-washing before and after meals rose to 100% for all patients, as well as the compliance of regular mask use was 100%. Similar trend is also seen in the caretakers, prior to the outbreak 75% of whom washed their hands before and 66.7% after they ate or handed food. ALL of them wore masks regularly in the hospital or outdoors. Since the outbreak, 100% of caretakers wore masks during outside and in the wards. Regardless of the children with ALL are immunocompromised patients, key message of infection prevention provided to the families were using alcohol to disinfect surfaces, avoid going to public transport and without visitor or travelling. Prior to the outbreak, internet consults consisted of 20% out of all patient consults. As of date, which is 160 days since the outbreak, 80% of patient consults are done via internet. ALL of patients are voiding public transportation. Private cars and taxi are their choices. ALL of them comply with the policy of just one companion and stayed at home unless have to get IV chemo or got likely infection. In April 2019, 21.38% of the ALL patients in inpatient department suffered febrile neutropenia. Otherwise, in April 2020, only 5.18% suffered febrile neutropenia.

**Conclusion:** From Jan 22 of 2020 to the authorship of this report, within the 200 number of ALL patients whom we have provided care for in Shenzhen Children's hospital, none of the patients as well as their families were infected with 2019-nCoV, and all of them received chemotherapy as planned. The infection rate of ALL patients suffered febrile neutropenia decreased by seventy-five percent. These outcomes demonstrated that our response to the public health emergency was on-time and appropriate. The operational result shows that the control measures taken are effective. Our experience suggest that

offering prompt and appropriate instructions in addition to provision of regular education and preventative practices to patients and their families may be considered to other pediatric oncology centers around the world.

## Induction

Acute lymphoblastic leukemia (ALL) is the most common pediatric malignancy (1) and is nearly 150 cases become newly diagnosed in Shenzhen Children's hospital annually. The 5-year survival rate of childhood ALL have achieved above 85% in developed countries (2). Infections constitute a major cause of morbidity and mortality in children with ALL undergoing therapy (3). We have found two issues of crucial importance for higher survival outcome: better supportive care and standardized treatment.

The city of Wuhan was the epicenter of 2019-nCoV outbreak in China in Jan-Feb of 2020 (4). As a response, the National Health and Care Commission of China published the New Coronavirus Pneumonia Diagnosis and Treatment Plan as a guideline for front-line healthcare practitioners in January 20, 2020 (5). Based on the government guidelines, the Hematology and Oncology Department of Shenzhen Children's Hospital provided a series of education and safety practices to leukemia patients and their families to prevent novel coronavirus pneumonia that fit the conditions of the hospital. None of the 200 children with leukemia and their family was infected with 2019-nCoV in Shenzhen Children's hospital. All of patients proceeded with their scheduled plans without interruptions.

The aim of this study was to investigate the importance of education of infection control practices among parents and children with ALL to raise awareness on SARS-Cor-2 prevention in time as a rapid response to public health emergency, and to assess their compliance to these preventive measures. Our study also showed that consistent, routine infection control education and practices to parents and children with leukemia in hematology/oncology department are quite important.

## Methods

The target population was leukemia patients and their caretakers during inpatient admission and outpatient clinics during the SARS-Cor-2 outbreak between Jan 21-May 23 of 2020. A questionnaire was done in person by a nurse while the patient was in hospital or by phone during March 19 and May 20, 2020. There were 423 confirmed cases as of May 18, 2020 in Shenzhen.

The questionnaire was designed to seek detailed information on the patient's and their caretakers' personal hygiene practices, training on hand-washing, the frequency of use of personal protective equipment, and their handling of environment and household materials before and after the outbreak.

We asked the frequency of hand-washing for children with ALL and their caretakers before and after they ate, handling food, after washroom visits. We also sought information on the use of soap, rubbing alcohol, and hand sanitizer for those who complied. For those who did not wash their hands, reasons for their incompliance.

Information on wearing of masks was collected on their use when they were outdoors and indoor in the hospital. The method of transportation they chose was also included.

All the returned questionnaires were checked for completeness of response, and supplementary information or missing data were requested when necessary.

Another cross-sectional survey was conducted among patients with ALL to study the rate of febrile neutropenia in hematology/oncology inpatient department in April 2019 and April 2020, respectively.

## Statistical Analyses

Frequencies and percentages were computed for all the questions in the questionnaire and tabulated in Tables 1 to 7. All the computation and analyses were performed using SPSS 11.5 for Windows.

## Results

A total of 180 (90%) caretakers of ALL children responded to our questionnaire survey. Summary statistics of the patients with ALL are shown in Table 1. There were 113 males and 67 females; 87.2% were more than 3 years old. 12.7% were under the age of 3. 88.8% of them have been diagnosed with leukemia over 2months and 11.1% were less than 2 months.

Table 1. Profiles of 180 patients

	N	percentage
Sex		
Boys	67	37.2%
Girls	113	62.7%
Age, yr		
Below 3	23	12.7%
3 or above	157	87.2%
Time of leukemia diagnosis		
More than 2months	20	11.1%
Within 2 months	160	88.8%
Missing	0	

The ages of caretakers ranged from 29 to 51(Table 2). 22 of the caretakers were fathers, 10 were grandma and the rest were mothers. 83.7% of the caretakers had a high school degree or higher education. 16.7% of the caretakers were less than secondary education. 13.8 of the caretakers are with a month income below 3000, 22.2% with monthly income of 3000-5000, 60% is 6000 or above.

Table 2. Summary statistics of 180 caretakers

	N	Percentage
<b>Gender</b>		
Female	158	87.8%
Male	22	12.2%
<b>Level of education</b>		
High school or above	150	83.3%
Below high school	30	16.7%
Missing	0	
<b>Age, yr</b>		
Below 30	22	12.6%
30-40	130	72.2%
Above 40	19	10%
Missing	9	5%
<b>Monthly income(Yuan)</b>		
6000 or above	108	60%
3000-6000	44	24.4%
Below 3000	25	13.8%
Missing	3	1.6%

Compliance with infection control measures for patients is shown in Table 3. Prior to the outbreak of coronavirus 2019-nCoV in Jan 2020, 91% and 78% the patients who are 3 or less than 3 years old wore masks when they are outdoors and in the hospital. 100% and 95.5% of the patients who are more than 3 years old wore masks when they are outdoors and in the hospital. Since the beginning of coronavirus 2019-nCoV epidemic since Jan of 2020, the proportions of patients who wear masks outdoors and indoors rose to 100%, respectively. For handwashing, 88.9% of the patient used Hibiscrub (Purell, Ohio, USA) (or other antibacterial liquid) and 11.1% used liquid soap. Since the 2019-nCoV outbreak, the corresponding proportions rose to 97.3% and 2.7%.

Table 3. Prevalence of use of infection control practices of patients

	Year	
	Before Jan 2020	After Jan2020
3 or below 3 years(n = 3)		
Ware mask		
Outdoors	21 (91%)	23 (100%)
In the hospital	18 (78%)	23 (100%)
Above 3 years		
Ware mask		
Outdoors	157 (100%)	157 (100%)
In the hospital	150 (95.5%)	157 (100%)
Washing hands		
Water and liquid soap	20 (11.1%)	5 (2.7%)
Other antibacterial liquid	160 (88.9%)	175 (97.3%)
Before ate	160 (88.9%)	180 (100%)
After ate	100 (55.6%)	180 (100%)

The frequency of use of personal protective equipment and handwashing as part of the infection control procedures for caretakers is shown in Table 4. Prior to the outbreak of coronavirus 2019-nCoV in Jan 2020, 100% of the caretakers wore masks during outside and in the wards. Since the beginning of coronavirus 2019-nCoV epidemic since Jan of 2020, the corresponding proportions were 100% too. As to hand hygiene, 135 of 180(75%) of caretakers washed their hands before and 66.7% (120) after they ate or handed food. The corresponding proportions were 100% and 99.4% during the investigation of the coronavirus 2019-nCoV outbreak. For hand-washing, 75% of the caretakers used alcohol-based hand sanitizers; 11.1% used antibacterial liquid soap and 25% used water only. After the outbreak, there is significant difference. 96.7% of the caretakers used alcohol-based hand sanitizers; 20% used antibacterial liquid soap and 0.5% used water only.

Table 4 Frequency of use of personal protective measures and handwashing practice of caretakers

	Year	
	Before Jan 2020	After Jan2020
Ware mask		
Outdoors	180 (100%)	180 (100%)
In the hospital	180 (100%)	180 (100%)
Washing hands		
Water and liquid soap	20(11.1%)	5(2.7%)
Other antibacterial liquid	135(75%)	174(96.7%)
Water only	25(13.9)	1(0.5%)
Before ate or handed food	135(75%)	180(100%)
After ate or handed food	120(66.7%)	179(99.4%)

Table 5 summarized the knowledge on infection control among the caretakers. One hundred (100%) caretakers responded that they were taught of these best practices upon children were diagnosed with leukemia, including: (1) the importance of hand hygiene, (2) the proper steps in hand-washing, (3) the direction of use of personal protective equipment, and (4) the use of disinfecting agents and proper handling of household items for better hygiene; (5) Only one caretaker allowed during hospital stay.

Table 5. Knowledge on infection control

	Yes (%)	No (%)	Missing (%)
Have you ever been educated on infection control practices(n =180)	180	0	0
Were the following educated?			
The importance of hand hygiene	175 (97.2)	2 (1.1)	3 (1.6)
The proper steps in hand-washing	174 (96.7)	2 (1.1)	4 (2.2)
The direction of use of personal protective equipment	160 (88.9)	14 (7.8)	6 (3.3)
The use of disinfecting agents and proper handling of household items for better hygiene	174 (96.7)	3 (1.6)	3 (1.6)
Only one caretaker allowed during hospital stay.	178 (98.9)	0	2 (1.1)

Table 6 shows the frequency of use of personal protective equipment as part of the infection control procedures for patients and caretakers. The mask of choice for all the respondents before outbreak was surgical masks (100%) but not N95 (0%). Since the beginning of coronavirus 2019-nCoV epidemic, the type of masks used 72.2% were for surgical masks and 27.8% for N95 respirators.

Table 6. Frequency of use of personal protective measures

	Year	
	Before Jan 2020	After Jan2020
Mask (n=180)		
N-95 respirator	0	50 (27.8%)
Surgical	180 (100%)	130 (72.2%)

Prior to the outbreak, internet consults consisted of 22.2% out of all patient consults. As of date, which is 160 days since the outbreak, 84% of patient consults are done via internet not outpatient department (Table 7).

Table 7 Frequency of use of internet consults

	Year	
	Before Jan 2020	After Jan 2020
internet consults	40 (22.2%)	151 (84%)

In April 2019, 21.38% of the ALL patients suffered febrile neutropenia admitted in the hospital wards. Otherwise, in April 2020, only 5.18% suffered febrile neutropenia (Table 8). The difference was highly significant.

Table 8. The rate of febrile neutropenia admitted in the hospital wards

	Year	
	Apr 2019	Apr 2020
febrile neutropenia admitted in the inpatient department	68(21.38%)	30(5.18%)

## Discussion

The aim of this study was to investigate the importance of education of infection control practices to leukemia patient families for 2019-nCoV prevention. We have conducted a survey on frequency of hand washing and the use of personal protective equipment among children with leukemia and their caretakers before or after the outbreak of coronavirus 2019-nCoV in China. None of the patients as well as their families was infected with 2019-nCoV in Shenzhen Children’s hospital. All of the patients have chemotherapy as planned. The infection rate of ALL patients suffered febrile neutropenia decreased by seventy-five percent in April 2020, compare with April 2019. The results indicated that good hand hygiene practices involve cleaning hands at appropriate time points in order to prevent infections in these high-risk infection-prone patients.

At the start of the outbreak of 2019-nCoV, the exact mode of transmission is still under investigation. In our experience, we provide professional advice: including ☐ Hand Hygiene and Hand Care; ☐ the use of masks; ☐ separation and sterilization of patient items; ☐ avoiding public transportation; ☐ Staying at home unless medically necessary; ☐ Telemedicine; ☐ Allowing only one caretaker during hospital admission ☐ minimizing patients and their families visiting or travelling.

The patients and their caretakers are voiding public transportation. Private cars and taxi are their choices. ALL of them comply with the policy of just one companion and stayed at home unless have to get IV chemo or got likely infection. We offer internet consults for our patients. The frequency of use internet consult was high. It is convenience, cheap, receptive and adaptable for the patients and caretakers.

The high prevalence of good hand hygiene practice among the patients and their caretakers is due to consistent, regular education and reinforcement. Several explanations can be given. As soon as the children diagnosed with leukemia our education team will give a series of education on hand-washing, personal preventive measures, and nutritional care for the well-being of the patients. We also test their knowledge and assess their hands-on practices. Our study showed that children with leukemia and their caretakers have a significantly high compliance to handwashing and use of personal preventive measures. After the 2019-nCoV outbreak, teaching on infection control and personal hygiene has been reinforced.

We widely recommend Alcohol-based handrub to patients and caretakers. The Evidence-based Practice in Infection Control (EPIC) study showed that an alcohol-based handrub provides the most effective decontamination for a wide variety of bacteria and viruses (6, 7). It is easy access and availability. Its use was high compared with using water and antibacterial liquid (soap) (11.1%).

The infection rate of febrile neutropenia in April 2020 was fairly dropped sharply, in contrast to the high rate in April 2019. There are two particular reasons; the first is practice of infection control measures, the second is possibly the protocol of ALL was just replaced in Sep 2019.

## **Conclusions**

We surveyed on their handwashing practice and use of personal protective equipment before and after the outbreak of 2019-nCoV. A significant improvement in compliance with hand hygiene practice was found after the 2019-nCoV outbreak. The infection rate of ALL patients suffered febrile neutropenia decreased by seventy-five percent. These outcomes demonstrated that our response to the public health emergency was on-time and appropriate. The operational result shows that the control measures taken are effective. Our experience suggest that offering prompt and appropriate instructions in addition to provision of regular education and preventative practices to patients and their families may be considered to other pediatric oncology centers around the world.

## **Declarations**

### **Ethics approval and consent to participate**

This study was approved by the ethics committee of Shenzhen Children's Hospital. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

### **Consent for publication**

Written consent to publish this information was obtained from the parent of the study participant.

## Data statement

The datasets generated and analyzed during the present study are available from the corresponding author on reasonable request.

## Competing interests

We declare that we have no financial and personal relationships with other people or organizations that may inappropriately influence our work.

## Funding

Not applicable

## Authors' contributions

XL and LSX and WFQ designed the majority of the experiments and data analysis, as well as writing the manuscript; YHY and LQL provided data analysis. All of the authors read and approved the final version of the manuscript.

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