Care of Pediatric Patients during COVID-19 Pandemic

Wuhan United “Living Through A Pandemic” Series 4

Co-organized with: Department of Pediatrics, Wuhan Union Hospital, Tongji Medical College,
Huazhong University of Science and Technology;
Forti & Consevage, P.C., Pennsylvania, USA
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Opening Remarks

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Diagnosis, Treatment and Prevention of COVID-19 in Children

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Information of Pediatric Patients in China

- 2143 pediatric patients with COVID-19 were reported to the Chinese Center for Disease Control and Prevention from January 16 to February 8, 2020
- 731 (34.1%) laboratory-confirmed cases and 1412 (65.9%) suspected cases.
- 1213 cases (56.6%) were boys. The age of disease onset ranged from 1.5m to 17y.
- The median time from illness onset to diagnoses was 2 days (range: 0 to 42 days).
- Of the 2143 pediatric patients, only one child died.
- Severe and critical cases (5.9%) were much fewer than adult patients (18.5%). Most cases were mild.

Dong Y, Mo X, Hu Y, et al. Epidemiological characteristics of 2143 pediatric patients with 2019 coronavirus disease in China. Pediatrics. 2020; doi: 10.1542/peds.2020-0702
Zheng F, , et al. Clinical Characteristics of Children with Coronavirus Disease 2019 in Hubei, China. Current Medical Science.40(2):1-6,2020
Lu X. et.al. COVID-19 Infection in Children. The New England Journal of Medicine. DOI: 10.1056/NEJMc2005073

Knowledge We have Obtained

- Children at all ages appeared susceptible to COVID-19.
- over 90% of all patients were asymptomatic, mild, or moderate cases.
- Compared with adult patients, the incidence in children was much lower.
- Compared with adult patients, clinical manifestations of children's COVID-19 was less severe, and the case fatality rate was much lower.
- Most of them had a close contact with infected cases or were family cluster cases.
- Young children, particularly those less than 3 years old, accounted for most cases in children. Most critical cases, which demanded extra attentions during home care and hospitalization, occurred in this age group as well.

Dong Y, Mo X, Hu Y, et al. Epidemiological characteristics of 2143 pediatric patients with 2019 coronavirus disease in China. Pediatrics. 2020; doi: 10.1542/peds.2020-0
Zheng F, , et al. Clinical Characteristics of Children with Coronavirus Disease 2019 in Hubei, China. Current Medical Science.40(2):1-6,2020
Lu X. et.al. COVID-19 Infection in Children. The New England Journal of Medicine. DOI: 10.1056/NEJMc2005073

Current Medical Science
DOI https://doi.org/10.1007/s11596-020-2172-6 40(2):1-6,2020

Clinical Characteristics of Children with Coronavirus Disease 2019 in Hubei, China

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Publication from Our Group

Outline

1. **Clinical features, Laboratory examination, Chest imaging**

2. **Diagnosis: Suspected cases, Confirmed cases, Classification of confirmed cases, Early identification of critical cases**

3. **Treatment, Release, and Discharge criteria**

4. **Prevention**

Shen, Y. Yang, T. Wang, et.al. Diagnosis, treatment, and prevention of 2019 novel coronavirus infection in children: experts' consensus statement. World Journal of Pediatrics. https://doi.org/10.1007/s12519-020-00343-7
Dong Y, Mo X, Hu Y, et al. Epidemiological characteristics of 2143 pediatric patients with 2019 coronavirus disease in China. Pediatrics. 2020; doi: 10.1542/peds.2020-0702

Clinical Features, Laboratory Examination, Chest Imaging

Clinical Characteristics

1. Latent period is 1~14 days, mostly ranging from 3 to 7 days.
2. Most have mild clinical manifestations: fever, dry cough, fatigue.
3. Most of them recover within 1–2 weeks after disease onset.
4. Some patients might appear asymptomatic.
5. Severe children have dyspnea, which can rapidly progress to ARDS, septic shock, metabolic acidosis, coagulation dysfunction and multiple organ failure.
6. No intrauterine infection cases have been reported yet.

Laboratory examinations

1. CBC, CRP, metabolic function, coagulation function in severe cases.
2. Other pathogens are detected if necessary.
3. Samples from nasopharyngeal swab, sputum, BALF, anal swab are tested for nucleic acids. Serum are tested for antibody.

Chest imaging examination: Chest X-ray or CT scan

Multiple small patchy shadows and interstitial changes in the lung periphery, further deteriorate to bilateral multiple ground-glass opacity and/or infiltrating shadows. Lung consolidation may occur in severe cases. Pleural effusion is rarely seen.

Diagnosis: Suspected Cases, Confirmed Cases, Classification of Confirmed Cases, Early Identification of Critical Cases

Diagnosis

How to identify a suspected case: Patients who meet any one of the criteria in the epidemiological history and any two of the criteria in clinical manifestations.

Epidemiological History

1. Children with a travel or residence history in epidemic area within 14 days prior to disease onset;
2. Children with contacting patients with fever or respiratory symptoms from epidemic areas within 14 days prior to disease onset;
3. Children who are related with a cluster outbreak or close contact with COVID-19 infected cases;
4. Newborns delivered by confirmed COVID-19 -infected mothers.

Clinical manifestations

1. Fever, fatigue, dry cough; some pediatric patients may have low-grade fever or no fever;
2. Positive chest imaging findings
3. In the early phase of the disease, WBC is normal or decreased, or with decreased lymphocyte count;
4. No other pathogens are detected which can fully explain the clinical manifestations.

Diagnosis

Confirmed Cases

Suspected cases who meet any one of the following criteria:

1. Respiratory tract or blood samples tested positive for COVID-19 nucleic acid using RT-PCR;
2. Genetic sequencing of respiratory tract or blood samples is highly homologous with the known COVID-19;
3. Specific IgM and IgG are positive. Specific IgG is positive from negative to 4 times higher than that in acute phase. (if detection of antibody is available)

Clinical Classifications of Confirmed Cases

1. **Asymptomatic infection**
2. **Acute upper respiratory tract infection**
3. **Mild pneumonia**
4. **Severe pneumonia**

   (1) Increased respiratory rate: ≥ 70 times/min (< 1 year), ≥ 50 times/min (≥ 1 year) (after ruling out the effects of fever and crying);
   (2) Oxygen saturation < 92%;
   (3) Hypoxia: assisted breathing (moans, nasal flaring, and three concave sign), cyanosis, intermittent apnea;
   (4) Disturbance of consciousness: somnolence, coma, or convulsion;
   (5) Food refusal or feeding difficulty, with signs of dehydration.

5. **Critical cases**

   (1) Respiratory failure requiring mechanical ventilation;
   (2) Shock;
   (3) Combined with other organs failure.

Population with High-risk:

1. Children with a history of contact with severe COVID-19 cases.
2. Children with underlying conditions: congenital heart disease, bronchial pulmonary hypoplasia, respiratory tract anomaly, with abnormal hemoglobin level, severe malnutrition.
3. Children with immune deficiency or immunocompromised status (under long-term use of immunosuppressants)

Early Identification of Critical Cases

1. Dyspnea: respiratory rate > 50 times/min for 2–12 months old; > 40 times/min for 1–5 years old; > 30 times/min in patients over 5 years old (after ruling out the effects of fever and crying);
2. Persistent high fever for 3–5 days;
3. Poor mental response, lethargy, disturbance of consciousness, and other changes of consciousness;
4. Abnormally increased enzymatic indexes, such as myocardial enzymes, liver enzymes, lactate dehydrogenase;
5. Unexplainable metabolic acidosis;
6. Chest imaging findings indicating bilateral or multi-lobe infiltration, pleural effusion, or rapid progression of conditions during a very short period;
7. Infants younger than 3 months;
8. Extrapulmonary complications;
9. Coinfection with other viruses and/or bacteria.
10. Significantly increased D-dimer and cytokines IL-6 and IL-10 *(need further discussion)*

Differential Diagnosis

Differential diagnosis should be made to distinguish from influenza virus, parainfluenza virus, adenovirus, respiratory syncytial virus, rhinovirus, human metapneumovirus, and other known viral infections, as well as *mycoplasma pneumoniae* and chlamydia pneumonia and bacterial pneumonia.

The coinfection of COVID-19 with other viruses and/or bacteria should be considered in diagnosis.

Treatment, Release & Discharge Criteria

Treatment

General treatment

Symptomatic treatment: acetaminophen orally, 10–15 mg/kg every time. Keep children quiet and administrate sedatives immediately when convulsions or seizure occur.

Oxygen therapy

Antiviral therapy: Interferon-α, Arbidol, oseltamivir and other drugs

Antibodies

Other drugs: Glucocorticoids, Immunoglobulin

Oxygen Therapy

When hypoxia appears, effective oxygen therapy should be given immediately including nasal catheter and mask oxygen; or high-flow oxygen therapy and non-invasive ventilation (NIV); or invasive mechanical ventilation (intermittent positive pressure ventilation, IPPV) should be undertaken when necessary.

Antiviral Therapy

Interferon-α

recommended usage is as follows:

1. Interferon-α nebulization: interferon-α 200,000–400,000 IU/kg or 2–4 μg/kg in 2 mL sterile water, nebulization two times per day for 5–7 days;
2. Interferon-α2b spray: 1–2 sprays on each side of the nasal cavity, the dose of interferon-α2b per injection is 8000 IU, once every 1–2 hours, 8–10 sprays/day for a course of 5–7 days.

Lopinavir/litonavir

Lopinavir/litonavir has been tried to apply to the treatment of adult patients with COVID-19 pneumonia, but its efficacy and safety remain to be determined.

Antibiotics

Arbidol, oseltamivir and other anti-influenza drugs

Glucocorticoids

The use of glucocorticoids should be based on the severity of systemic inflammatory response, degree of dyspnea, with or without ARDS, and the progress status of chest imaging results. Glucocorticoids can be used in a short period (3–5 days). The recommended dose of methylprednisolone should not exceed 1–2 mg/kg/day.

Immunoglobulin

Immunoglobulin can be used in severe cases when indicated, but its efficacy needs further evaluation.

Release and Discharge Criteria

Confirmed patients can be discharged from isolation or transferred to the corresponding departments for treatment of other diseases if all the following criteria are met:

- The body temperature returns to normal longer than 3 days;
- The respiratory symptoms improve obviously;
- The detection of respiratory pathogenic nucleic acid is negative for two consecutive times (the sampling interval is at least 1 day).

Suspected patients can be discharged from isolation when the detection of respiratory pathogenic nucleic acid is negative for two consecutive times (the sampling interval is at least 1 day).

Prevention

- **Controlling infection sources**
- **Blocking transmission routes**
- **Boosting immunity**

Management of Wards of Pediatric Hematological-Malignancy during COVID-19

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Challenges

1. Coronavirus pandemic
2. Transformation of hospitals in Wuhan for treatment of COVID-19 patients
3. Shortage of trained nurses and doctors: hospitals were open for COVID-19 patients and staff were assigned to isolation wards in batches
4. Shortage of protective materials at initial stage
5. Limitation of the test-kits at initial stage; had to select out strong suspected cases for RNA test
6. Hematologic-malignancy patients had been stranding out of hospitals and waiting on the list for admission for chemotherapy.

Outline

1. A flowchart strategy for pre-admission management

2. Management of wards: formulated systems, inpatients, guardians and staff

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Chin J Contemp Pediatr

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儿童新型冠状病毒感染专栏

2019 冠状病毒病流行期间儿童血液肿瘤病房规范化管理建议

湖北省儿科学会血液肿瘤学组

［摘要］ 随着 2019 冠状病毒病（COVID-19）的流行及各地诊治经验的积累，目前已明确，儿童对严重急性呼吸综合征冠状病毒 2（SARS-CoV-2）同样易感。儿童血液肿瘤患儿是一类特殊人群，由于血液肿瘤疾病本身的因素和治疗特点，患儿机体处于特殊免疫状态。现根据血液肿瘤患儿的特点，制订 COVID-19 流行期间儿童血液肿瘤病房管理指导意见，以供参考。 ［中国当代儿科杂志，2020，22（3）：177-182］

［关键词］ 2019 冠状病毒病；严重急性呼吸综合征冠状病毒 2；血液肿瘤；病房管理；儿童

Standardized management guideline for pediatric wards of hematology and oncology during the epidemic of corona virus disease 2019

Subspecialty Group of Hematology and Oncology, Society of Pediatrics of Hubei (Wu X-Y, Email: xwu@hust.edu.cn)

Abstract: With the spread of corona virus disease 2019 (COVID-19) and growing knowledge of its diagnosis and treatment, it has been clear that children are also susceptible to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The children with hematological tumors are a special population with immunosuppression and special therapeutic characteristics. Here the management guideline for pediatric wards of hematology and oncology during COVID-19 epidemic is established based on the features of children with hematological tumors.

[Chin J Contemp Pediatr, 2020, 22(3): 177-182]

Key words: Corona virus disease 2019; Severe acute respiratory syndrome coronavirus 2; Hematology and oncology; Ward management; Child

自 2019 年 12 月以来，以湖北省武汉市为　　版）》[1]，以及《湖北省儿童新型冠状病毒感染诊

Publication from Our Group

A Flowchart Strategy for Pre-admission Screening

Evaluation Tests

- Complete blood counts
- C-reactive protein
- Chest CT scans
- Tests for common respiratory pathogens, including influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, *mycoplasma pneumoniae*, and *chlamydia pneumoniae*.

Evaluation for Suspected Cases

Epidemiology history plus two of the following criteria are considered suspected cases:

1. Symptoms
2. Viral pneumonia by CT scan
3. Unexplained clinical manifestations with a negative result of common respiratory pathogens tests

The Confirmed COVID-19 Cases

- One in 110 cases
- Suspected COVID-19 of the mother (CT with typical viral pneumonia)
- No symptoms for the child
- Positive chest CT scan (slight unilateral patchy shadow)
- Negative test of common respiratory pathogens
- Positive viral test for COVID-19 at pre-admission screening
- Transferred to Wuhan Children’s Hospital (the designated hospital for pediatric COVID-19)

Other Considerations: Sample Collection

- Nasal-pharyngeal swab is recommended for higher sensitivity and compliance compared to throat swab

- High risk. Level III protection of collectors, including disposable surgical cap, medical protective mask (N95), work uniform, disposable medical protective uniform, disposable latex gloves, full-face respiratory protective devices or powered air-purifying respirator

Other Considerations: Guardians

- Complete blood counts
- C-reactive protein
- Chest CT scans
- Tests for common respiratory pathogens, including influenza virus, respiratory syncytial virus, adenovirus, parainfluenza virus, *mycoplasma pneumoniae*, and *chlamydia pneumoniae*
- COVID-19 nuclear acid test
- COVID-19 antibody test

Management of Wards: Formulated systems, Inpatients, Guardians & Staff

Wards Management: Formulated Systems

Formulate the systems of the ward during the pandemic:

- Prevention and control infection system;
- Consultation system for new suspected cases;
- Admission process and requirements for patients and guardians;
- Prompt response for new suspected or confirmed children in the ward.

Wards Management: Patients

- One patient one room (a buffer ward and a treatment ward)
- Patients excluding COVID-19 receive chemotherapy as planned
- Patients who needed a second viral test were admitted to a buffer ward isolated from the treatment ward
- Health education
- Support and psychological intervention by volunteer consultants, social workers if needed

Wards Management: Guardians

- One guardian permitted for each patient and two if necessary
- Guardians should have been excluded from COVID-19 as well
- Health education
- Support and psychological intervention by volunteer consultants, social workers if needed

Wards Management: Staff

Training: Use the network training platform, learn the standard wearing and taking off protective clothing, the standard collection and delivery of samples, procedures for prevention and control of nosocomial infection, etc.

Wards Management: Staff

- Different protection levels: the treatment ward (Level I), buffer ward (Level II), and high-risk operations (Level III)
- Hand hygiene is critically important
- No gathering (no meeting, separately eating, separately rest)
- Self monitor everyday including body temperature, symptoms
- Applied to everyone including doctors, nurses, and other work staff

Prompt Response for New Suspected or Confirmed Children in the Ward

In case of suspected case in the ward, the chemotherapy should be suspended immediately, effective isolation and treatment should be taken for the patient. Report to the hospital management office, request the expert group for consultation, and request the nucleic acid test.

Once the diagnosis is confirmed , the special vehicle shall be used to transfer to the designated hospital for treatment according to the standard requirements. The original isolation room shall be disinfected in accordance with the medical procedure and the machine issued by the general office of the national health commission.

Protection for Medical Staff

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Workflow Management

1) Before working in a fever clinic and isolation ward, the staff must undergo strict training and examinations to ensure that they know how to put on and remove personal protective equipment. They must pass such examinations before being allowed to work in these wards.
2) The staff should be divided into different teams. Each team should be limited to a maximum of 4 hours of working in an isolation ward. The teams shall work in the isolation wards (contaminated zones) at different times.
3) Arrange treatment, examination and disinfection for each team as a group to reduce the frequency of staff moving in and out of the isolation wards.
4) Before going off duty, staff must wash themselves and conduct necessary personal hygiene regimens to prevent possible infection of their respiratory tracts and mucosa.

Reference: “Handbook of COVID-19 Prevention and Treatment”
The First Affiliated Hospital, Zhejiang University School of Medicine

Health Management

1) The front-line staff in the isolation areas – including healthcare personnel, medical technicians and property & logistics personnel – shall live in an isolation accommodation and shall not go out without permission.

2) A nutritious diet shall be provided to improve the immunity of medical personnel.

3) Monitor and record the health status of all staff on the job, and conduct health monitoring for front-line staff, including monitoring body temperature and respiratory symptoms; help address any psychological and physiological problems that arise with relevant experts.

4) If the staff have any relevant symptoms such as fever, they shall be isolated immediately and screened with an NAT.

5) When the front-line staff including healthcare personnel, medical technicians and property & logistics personnel finish their work in the isolation area and are returning to normal life, they shall first be NAT tested for COVID-19. If negative, they shall be isolated collectively at a specified area for 14 days before being discharged from medical observation.

COVID-19 Related Personal Protection Management

Protection Level	Protective Equipment	Scope of Application
Level I protection	• Disposable surgical cap • Disposable surgical mask • Work uniform • Disposable latex gloves or/and disposable isolation clothing if necessary	• Pre-examination triage, general outpatient department
Level II protection	• Disposable surgical cap • Medical protective mask (N95) • Work uniform • Disposable medical protective uniform • Disposable latex gloves • Goggles	• Fever outpatient department • Isolation ward area (including isolated intensive ICU) • Non-respiratory specimen examination of suspected/confirmed patients • Imaging examination of suspected/ confirmed patients • Cleaning of surgical instruments used with suspected/confirmed patients
Level III protection	• Disposable surgical cap • Medical protective mask (N95) • Work uniform • Disposable medical protective uniform • Disposable latex gloves • Full-face respiratory protective devices or powered air-purifying respirator	• When the staff performs operations such as tracheal intubation, tracheotomy, bronchofibroscope, gastroenterological endoscope, etc., during which, the suspected/confirmed patients may spray or splash respiratory secretions or body fluids/blood • When the staff performs surgery and autopsy for confirmed/suspected patients • When the staff carries out NAT for COVID-19

We Need to Know…

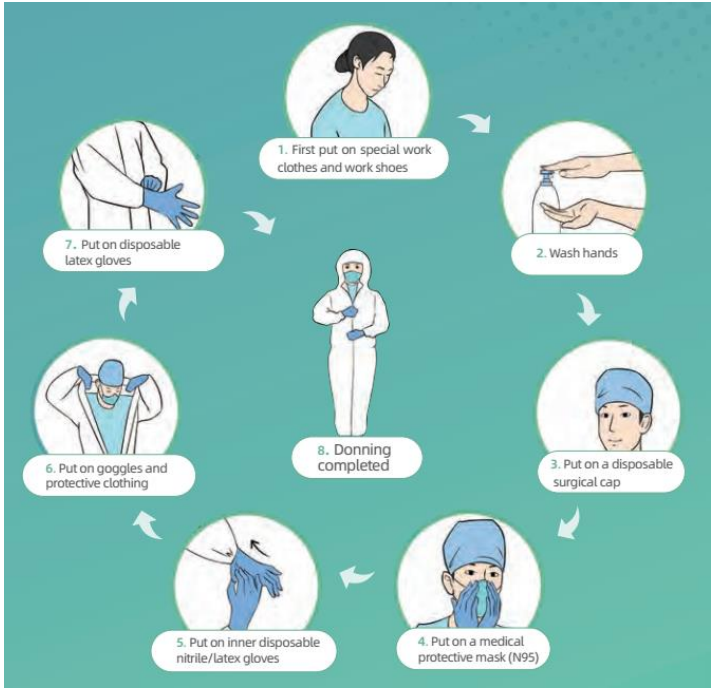
1. All staff at the healthcare facilities must wear medical surgical masks;

2. All staff working in the emergency department, outpatient department of infectious diseases, outpatient department of respiratory care, department of stomatology or endoscopic examination room (such as gastrointestinal endoscopy, bronchofibroscopy, laryngoscopy, etc.) must upgrade their surgical masks to medical protective masks (N95) based on Level I protection;

3. Staff must wear a protective face screen based on Level II protection while collecting respiratory specimens from suspected/confirmed patients.

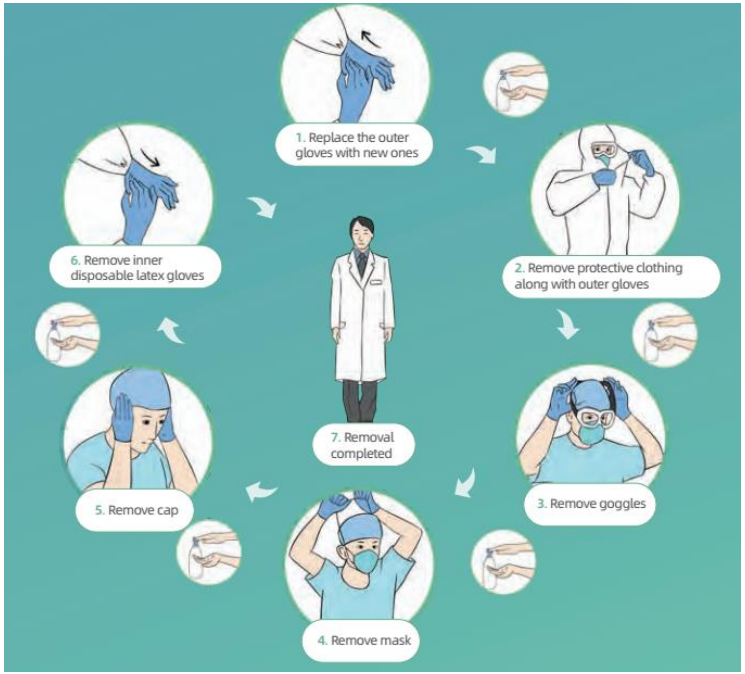
Guidance on Donning and Removing Personal Protective Equipment (PPE) to manage COVID-19 Patients

Protocol for Donning PPE:



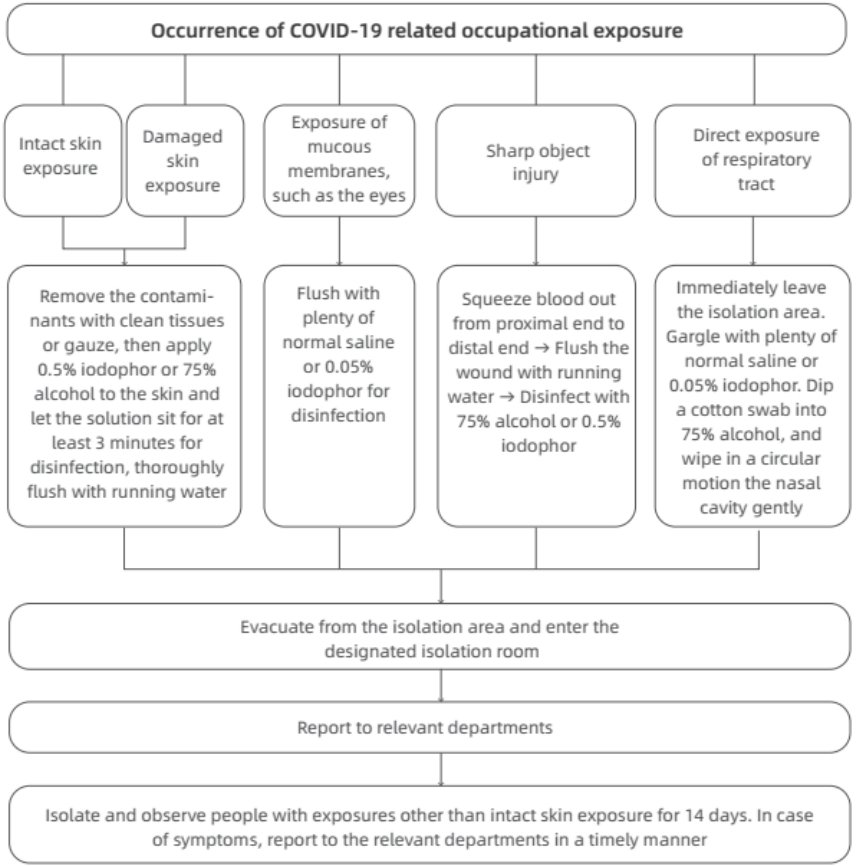
1. Put on special work clothes and work shoes
2. Wash hands
3. Put on disposable surgical cap
4. Put on medical protective mask (N95
5. Put on inner disposable nitrile/latex gloves
6. Put on goggles and protective clothing (note: if wearing protective clothing without foot covers, please also put on separate waterproof boot covers), put on a disposable isolation gown (if required in the specific work zone) and face shield/powered air-purifying respirator(if required in the specific work zone)
7. Put on outer disposable latex gloves

Protocol for Removing PPE:



1. Wash hands and remove visible bodily fluids/blood contaminants on the outer surfaces of both hands
2. Wash hands replace outer gloves with new gloves
3. Remove powered air-purifying respirator or self-priming filter-type full-face mask/mask (if used)
4. Wash hands
5. Remove disposable gowns along with outer gloves (if used)
6. Wash hands and put on outer gloves
7. Enter Removal Area No. ①
8. Wash hands and remove protective clothing along with outer gloves (for gloves and protective clothing, turn inside out, while rolling them down) (note: if used, remove the waterproof boot covers with clothing)
9. Wash hands
10. Enter Removal Area No. ②
11. Wash hands and remove goggles
12. Wash hands and remove mask
13. Wash hands and remove cap
14. Wash hands and remove inner disposable latex gloves
15. Wash hands and leave Removal Area No. ②
16. Wash hands, take a shower, put on clean clothes and enter the clean area

Procedures for Taking Remedial Actions against Occupational Exposure to COVID-19



Key Points

Correct protection

Wash hands

Adequate sleep

A nutritious diet

Optimistic attitude

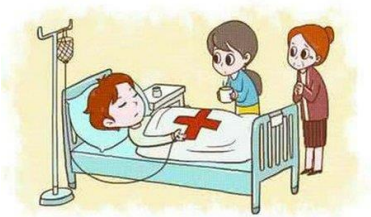
Management of Children with Other Non-COVID-19 Related Health Care Needs

Patient Classification

COVID-19
Designated Hospitals

Fever, cough,
shortness of
breath,
sore throat

General Hospitals



Tumor
Chronic diseases
(kidney disease, heart
disease)
Premature infant

In General Hospitals

Outpatient

Hand disinfection before and after consultation
Level II protection

Inpatient

Three items are needed to perform before admission.
COVID-19 nucleic acid testing (NAT)
Antibodies test (IgM and IgG)
CT scan in lungs

Patients will be settled in a single room and receive the second nucleic acid testing.
If negative in all, patients will exclude the possibility of COVID-19 infection.

Online Consultation Clinic

- Free for children with any symptoms all over the country
- 24/7
- Prescribing and mailing drugs

Key Lessons from Wuhan

- Controlling the source of infection through early detection, early diagnosis, early isolation and early treatment
- Personal protection is very important for medical staff
- Strict lockdown for the general public

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Resources

- CDC
  https://www.cdc.gov/coronavirus/2019-nCoV/index.html

- Johns Hopkins daily update
  http://www.centerforhealthsecurity.org/resources/COVID-19/index.html

- Diagnosis and Treatment Protocol for COVID-19" 7th edition by National Health Commission of China
  https://drive.google.com/file/d/1faYLhQxS0dEV2HVcigwxL531tSYCJpOv/view?usp=sharing

- The Chinese Telemedicine Team Is Here to Fight against COVID-19 (Jack Ma & Alibaba)
  https://covid-19.alibabacloud.com/

Thank You !

Organized by
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