A Practical Handbook for Infection Control in Makeshift (*Fangcang*) Hospitals:

Experience from Coronavirus Disease 2019 (COVID–19) Pandemic

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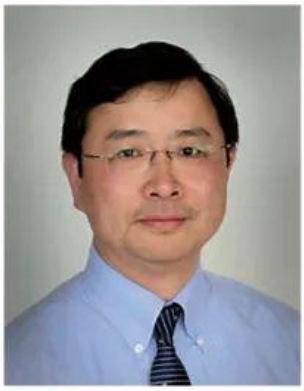

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Acknowledgement

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Abstract

Makeshift (*Fangcang*, FC) Hospital (Square cabin hospital in Chinese), is a rapidly converted large space, makeshift shelter-like hospital. A number of FC hospitals have been converted and established in Wuhan, Hubei Province, in order to provide care for the rapidly increasing patient population infected with coronavirus caused by the 2019–nCoV. As an innovative approach to deal with large patient populations during the pandemic, FC hospitals became the major centralized facility to receive and treat confirmed cases with diagnosis of 2019–nCoV infection and mild pneumonia symptoms. Because the very nature of these FC hospitals is a large open space with many patient beds, it is critical to maintain excellent practices for management of personnel and facilities as well as protecting all patients from nosocomial infections.

This practical handbook is applicable for the management of large-scale FC hospitals during the pandemic of COVID–19. The handbook is based on the on-site practice and experience in Wuhan FC Hospitals, and is designed to prepare others regarding health risk provider protections and patient safety. The authors have developed measures and countermeasures including, but not limited to, functional zoning, hygienic and health facilities, personal protection, and management systems, as well as, technical guidance for stakeholders in both the building and management of large-scale FC hospitals as part of pandemic control strategy. The intrinsic value of this handbook is that the authors offer practical advice according to cases encountered in the field.

This book is published in both Chinese and English for the convenience of colleagues in China and around the world.

Foreword

Right around the lunar Chinese New Year, at the end of 2019 and the beginning of 2020, a pneumonia pandemic infected tens of thousands with novel coronavirus. Ground zero was determined to be Wuhan City of Hubei Province, The 2019–nCoV, now called COVID–19, became pandemic with rapid transmission and extraordinary infection capacity, causing a major public health emergency and negatively impacting the public first in Wuhan, Hubei, China, and ultimately around the world. The virus has posed significant and profound public health, societal and economic challenges on the world stage. The burden of a rapidly infected population requiring acute and critical care services as well as the public health challenges of infection control, containment and intervention promoted the development of unique initiatives designed to care for patients at large.

The large-scale makeshift (*Fangcang*, FC) hospital is an example of one such initiative. Existing buildings with large spaces and large capacity such as gymnasiums and exhibition centers have been designated for conversion to temporary FC hospitals. In just 20 days, an extraordinarily short time, 14 large-scale FC hospitals with a total of 12,365 beds were converted and opened. Patients infected with 2019–nCoV and with mild pneumonia in Wuhan have been admitted to FC hospitals and received medical care. FC hospitals are focused on controlling the source of infection effectively, and designed to limit and control the epidemic situation.

FC hospitals are staffed with medical care teams from many hospitals in different regions outside of Hubei province. In addition, corresponding personnel for security, catering services, and medical waste management, environmental disinfection and many other services are required for an efficient FC hospital. With various aspects of the complexity in patient management and hospital infection control in large open complex, with extreme contagious features of COVID–19, the requirements for facility environment,

medical procedures and personnel protection are extremely high. Management of infection prevention and control in the converted FC hospital and preventing the spread of the infection is the major task and top priority for building and managing the FC hospitals. Patients with mild symptoms were cared for in the large-scale FC hospitals, due to the centralized facilities with more than 1,000 patients with confirmed diagnosis, the average length of stay is over 10 days.

Unfortunately, as of February 28, 2020, more than 3,000 medical personnel across the country of China have been diagnosed with COVID–19 infection. The current pandemic situation is still grim and complex, and prevention and control are at the most critical stage. In addition to the busy and intensive work of pandemic prevention and control, we summarized our experience and prepared this book, for advising others regarding management of large FC hospital during coronavirus pandemic, for protecting the health and reducing the risk of infection of patients as well as the all of the staff, particularly front–line providers. This infection control manual presents comprehensive recommendations for health risk prevention and strategies, including functional zoning, healthcare facilities, personal protection, as well as management systems.

The members of the team contributed in writing this book are front-line hospital professionals in Wuhan FC Hospitals. They come from Shanghai, Shanxi, Jiangsu, Ningxia, and Xinjiang Production and Construction Corps as National Emergency Medical Response Teams. The FC hospitals include the Dongxihu FC Hospital (1,461 beds), Wuhan Jingkai FC Hospital (1,000 beds), and Qingshan FC Hospital (388 beds). Members are familiar with the processes inside and outside the FC hospitals and the responsibilities of each assignment. This book covers all aspects of infection control in the FC hospitals. Many questions encountered by front–line staff can be answered in this book, for example, how to choose appropriate protective clothing? Should I wear goggles or protective clothing first? What are the differences between the disinfection requirements and waste disposal in the FC hospitals?

In the fourth chapter of this book, we carry out analysis based on these typical cases we have encountered in the practical work of Wuhan FC Hospitals.

Although COVID–19 pandemic in China is gradually under control, the number of COVID–19 cases in South Korea, Italy, Iran, Japan and other countries continue to increase, which indicates the risk of potential global pandemic. On February 23, 2020, a World Health Organization (WHO) expert group inspected and commented positively on the construction

and operational management of FC hospitals in Wuhan. As part of the government's effort to put the lives and health of the people first, the FC hospital has played an important role, as a makeshift but well developed model of care, and the strategies may be applied everywhere.

As the COVID–19 is caused by novel coronavirus, 2019–nCoV, there will be many medical and research progress, including biosafety and infection control. Infection control system and standard operation procedure will be updated accordingly. Although this book represents recent clinical experience in the field, due to time constraints and limited knowledge, it is inevitable that there may be shortcomings and even errors. I implore readers to forgive me and other authors, as the situation and the impending evidence continues to be fluid.

Wenjuan Wu

Wuhan, February 28, 2020

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Chapter 1

Overview of FC Hospital

1. Background of FC hospital construction

At the beginning of 2020, a new type of pneumonia (COVID–19) caused by novel coronavirus (2019–nCoV) started to appear in Wuhan City, and major public health emergencies at the level one were launched by Chinese government. According to the strategy and principle to centralize effort for patient care, centralize medical experts and resources, and focus on treatment, severe cases of infection were treated in designated medical centers with strong comprehensive strength, and all non-severe cases and confirmed patients should be treated in a timely manner as well. As the number of confirmed cases of COVID–19 increased in countries and regions outside of China, the World Health Organization (WHO) committee held a meeting on January 30, 2020 in Geneva, announcing that China's 2019–nCoV pandemic constituted "Public Health Emergency of International Concern (PHEIC)".

With the development of pandemic, the transmission capability of COVID–19 was shown significantly stronger than SARS virus, the number of family clustering cases increased, and the number of confirmed cases of COVID–19 in Wuhan has continued to rise. As patients with confirmed cases could not be admitted to hospitals for isolation and treatment in a timely manner, which caused cross infection in the community and led to the spread of cases. In order to control the infection and develop the strategy dealing with the pandemic, on February 3, 2020, Hubei Province Pandemic Control Committees decided classified treatment, construction of large FC hospitals in Wuhan. FC hospital, means square cabin hospital in Chinese. National Emergency Medical Team and Wuhan City formed a medical team to manage the converted FC hospital, provide centralized treatment of patients with confirmed diagnosis of COVID–19 with minor symptoms. On the other hand, those patients confirmed with COVID–19 with severe and critical illness would be admitted to designated hospitals for treatment. In this way, better quarantine, effective control of the source of infection and potential transmission route, would result in improving cure rate and reduction of mortality rate.

On February 4, 2020, twenty National Emergency Medical Teams from across the country and three mobile P3 laboratories arrived in Wuhan. A total of more than 5,000 medical and laboratory staff were responsible for the medical work of FC Hospitals.

These FC hospitals, namely, the Wuchang FC Hospital, Jianghan FC Hospital and Wuhan Dongxihu FC Hospital, were converted and rebuilt in 3 days. Three FC hospitals began operation right away. The first batch of 9 FC hospitals, with a total of 7,185 beds, have been converted and built in rapid speed, in large-scale, with large teams. It is truly record-breaking.

In the overall deployment of control and prevention of COVID–19, centralized treatment of infected patients with minor symptoms, is one of the keys to controlling the source of transmission. The conversion and construction of a large FC hospital is considered as a pioneering effort to control and prevention of COVID–19 pandemic. On February 12, Chinese government again emphasized that it was necessary to implement early detection, early reporting, early quarantine, and early treatment, and ultimately cut off the transmission, and reduce the infection rate. A number of new FC hospitals were converted and put into use. The medical and infection control staff from first batch of FC hospitals provided on-site guidance and valuable experience.

2. Basic situations

The FC hospital is composed of a number of square cabins with different medical or technical functions, and has the ability to implement early treatment. The hospital is not only equipped with conditions such as mobile sanitary facilities for hand hygiene, medicines cabinets and sterilized equipment, continuous power supply etc., but also is capable for surgical operations, laboratory testing, ultrasound, X-ray and so on. Due to its features of mobile capability, rapid deployment, and adaptability in the situations, it can adapt to emergency medical missions.

Such FC hospital has been used in emergency medical rescue missions such as the Wenchuan earthquake and Qinghai Yushu earthquake. It has been used in dealing with severely injured people in the disaster area and has undergone practical applications. It has effectively been a fast and mobile alternative to conventional hospitals.

The FC Hospitals for COVID–19 are converted and built from buildings such as gymnasiums, convention centers, and workshops in Wuhan. It was selected and reconstructed based on large open space, away from residential areas, and well ventilation. Since February 4, 2020, Wuchang FC Hospital, Jianghan FC Hospital and Wuhan Dongxihu FC Hospital have been established from Hongshan Stadium in Wuchang District, Wuhan

International Convention and Exhibition Center in Jianghan District, and Wuhan Salon in Dongxihu District. The number of patients admitted varies from 200 to 1,500 depending on the size of the hospital. As of February 24, fourteen FC hospitals have been built, with 12,365 beds. Newer FC hospital may be constructed pending the need.

3. The function zoning of facilities

The FC hospital normally includes patient ward area, imaging/radiology area, clinical laboratory test area, viral nucleic acid detection area, and intensive care area.

(1) The ward area: Area with designated ward and mobile ward units, where patients stay for treatment and observation.

(2) The medical imaging/radiology area: Area with multiple sets of imaging systems for X-ray, CT, and ultrasound.

(3) The clinical laboratory test area: Area with multiple sets of laboratory test systems, such as routine blood.

(4) The viral nucleic acid detection area: Area with mobile BSL–3 (P3) laboratory, for molecular detection of coronaviruses.

(5) Intensive care area: Relatively isolated area for observation and treatment of patients who become exacerbated during hospitalization. Area is equipped with necessary medicine, oxygen cylinders, emergency medical equipment and supplies for resuscitation, respiratory aids, monitors, ambulance cots, etc. Though there is designated medical staff, this area is used only for transitional management. Patients who need ventilator support should be transferred to designated hospitals for treatment.

4. Patient admission criteria

According to "*Guidelines on the COVID–19 Diagnosis and Treatment (Trial 7th Ed.)*" and the actual situation, confirmed cases of COVID–19 shall meet the following admission criteria to the FC hospital:

(1) Patients with mild type presentation (minor clinical symptoms and no pneumonia by radiology), or with general type presentation (fever, respiratory tract symptoms, and pneumonia by radiology).

(2) Patients have the ability to live independently and can walk on their own.

(3) Patients have no serious chronic diseases, including hypertension, diabetes, coronary heart disease, malignant tumors, obstructive pulmonary disease, pulmonary heart disease, and immunosuppressed condition.

(4) Patients have no history of mental illness.

(5) In the resting state, blood oxygen saturation (SpO_2) is>93%, and the breathing rate or respiratory rate (RR) is<30 times/minute.

(6) Patients with other situation that needs special explanation.

5. Patient transfer criteria

Patients treated in FC hospital can be transferred to designated hospital for treatment if one of the following conditions occurs:

(1) Respiratory distress, RR ⩾ 30 times/min.

(2) In resting condition, finger oxygen saturation ⩽ 93%.

(3) Arterial partial pressure of oxygen (PaO_2)/fraction of inspired oxygen (FiO_2) ⩽ 300 mmHg (1 mmHg = 0.133 kPa).

(4) Imaging showed that pulmonary finding progressed more than 50% within 24 to 48 hours.

(5) With severe chronic diseases, including hypertension, diabetes, coronary heart disease, cancer, obstructive pulmonary heart disease and other immunosuppressed patients.

(6) Other special emergency reasons.

6. Patient discharge criteria

After treatment, patients meet all of the following conditions can be discharged:

(1) Normal temperature for over 3 days.

(2) Respiratory symptoms improved markedly.

(3) Pulmonary imaging showed significant absorption and improvement.

(4) Negative nucleic acid tests for COVID-19, from 2 consecutive respiratory specimens over one day apart.

Patients who meet the above conditions need to be consulted by experts. Both providers at the ward and the hospital should agree that the patient conditions meet the discharge criteria.

(Wenjuan Wu)

Chapter 2

Design of FC hospital and technical requirements for conversion and reconstruction

The FC hospital is based on Chinese military mobile medical system to deal with the situation with a lot of new infected patients, and make full use of existing buildings, in the shortest possible time. This would minimize the cost of the construction and renovation, so as to achieve the goal of effectively controlling infection and maximizing patient treatment. For characteristics of large space and large capacity, design and reconstruction must follow the principle of building structure safety, facility equipment operation safety, fire and environmental safety, and most importantly safety for infection management and prevention to ensure the safety of all staff and patients.

The conversion or transformation of the FC hospital shall include but not limit to outdoor municipal facilities, sewage treatment facilities, building internal partitions or sections, internal facilities and equipment, pathway to outside building, access routes for personnel and supplies, protection and improvement of adjacent environments, infection prevention and control, biological safety and security.

1. Building compliance requirements for reconstruction and hospital conversion

The building chosen to be converted could be single-story or multi-story, and the fire resistant rating should not be lower than the class 2. Fire protection zones, safe evacuation, building structures, fire control facilities, and fire lanes should meet the relevant requirements of national standards.

Site selection should try to avoid high-density residential areas, kindergartens, elementary schools and other urban crowded areas. If necessary, nearby residents may consider temporarily moving out, clear sign needs to be set up around the hospital with needed buffer zone. If there is green tree or bush separation, the distance between the existing building and the surrounding ones shall be not less than 20 meters. If there is no greening separation, minimum of 30–meter distance is recommended.

There should be parking and gathering space at the entrance of the converted building for ambulance vehicles and for rapid evacuation if needed. This space shall be barrier-free, is needed and reserved for facilitating traffic, and for temporary parking. It should have relatively comprehensive security around the site, ample outdoor space, and space for tents

to be set up. Related medical equipment can be installed for patient diagnosis and treatment, and for monitoring. As the internal building space shall be easy to be sectioned, public buildings with good facilities and fire equipment, such as convention centers, gymnasiums, new apartments, vacant dormitories, hotels, and schools, can be considered and selected.

Existing buildings with water supply and drainage, power supply, electronic communication capability, and other municipal facilities shall meet the requirements of FC hospital, and certain modification and reconstruction.

The floor plan, floor level and height, structure of existing buildings should meet the requirements as well.

Before selection, existing buildings with good structural conditions should be inspected, evaluated for structural conditions. The structure of the house should be a frame structure or a large-span structure to facilitate internal demolition, conversion.

2. Building floor plan, layout and partition isolation requirements

(1) The overall requirements of the building plan

Floor plan shall include three areas (dirty or contaminated, semi-clean, and clean areas) and two passages (medical staff and patient passages or corridors). Plan and design of reconstruction shall include traffic control for doctors and patients, separation of clean and contaminated areas, negative pressure ventilation systems, and isolation wards, and implementation of hospital security systems, in accordance with relevant national regulations.

(2) Specific requirements for three areas and two passages/corridors

Dirty or contaminated areas for patients with mild symptoms include waiting area, admission and discharge area; treatment area such as wards, procedure room, and garbage area. Semi-clean areas (also known as buffer zone) are in-between the dirty and clean areas, include places possibly contaminated with patient body fluids like blood, such as medical personnel offices, nurse stations, room with medical equipment, and corridors, etc. Clean areas or zones include dressing room, food-preparation, duty room, and warehouse. The medical staff and the patient passages/corridors shall be completely separated. Three areas can be distinguished using different colors (Figure 2–1) .Clean area is labeled as green, dirty area in pink, and semi-clean/buffer area in grey colors.

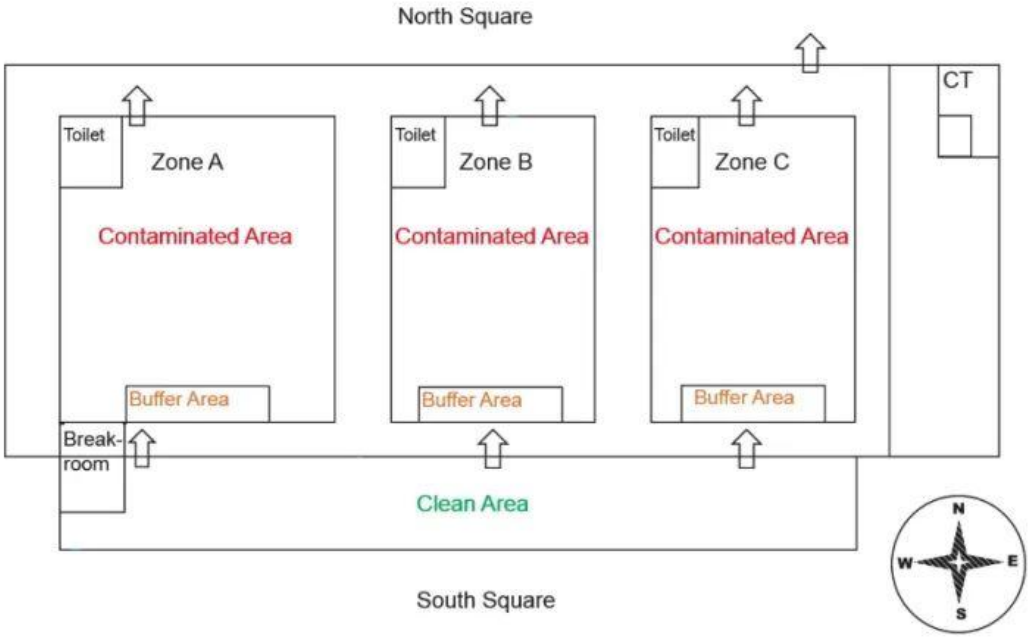

Figure 2–1 Three areas and two passages/corridors

(3) Donning and doffing

Walkthrough or workflow design and process should include use of clean room to enter clean area, and use of through room to exit dirty or contaminated areas. Donning steps or entry process shall be dressing room, donning-donning room, and buffer room for medical staff to dress personal protection, walk from clean room into cabin or patient ward. Doffing step or return process shall be buffer room, doffing-doffing room, bufter room, shower room, and locker room. Return locker room should be separated by men or women.

(4) Requirements for beds and signs

Each section or partition of patient ward or cabin shall have clear signs and labels. Area for men and women shall be separated. Each section of ward shall not have more than 42 beds. Each partition or section should have two evacuation or emergency exit. The distance between the evacuation exit and patient section should not exceed 30 meters (m). Fire evacuation passages should be identified between the areas. The width of the fire evacuation passages between zones should not be narrower than 4 meters in high spaces. The ground evacuation signs on the ground or floor shall be indicated to the sections. Partition material for cabins or beds should be fireproof, easy to clean surface, with the height lower than 1.8

meters. The beds should be arranged at a suitable distance to facilitate care and treatment. The clear distance between two paralleled beds should not be narrower than 1.2 meters, and a bedside table should be provided. The clear distance of the aisle between double beds (bed end) should not be narrower than 1.4 meters. Width of the aisle between single bed and the wall shall not be less than 1.1 meters.

(5) Evacuation requirements

After conversion or construction, for each floor or tall space, the number of people allowed to be accommodated should be determined according to the width of the evacuation exit stairs and safety exits. The net width of the safety exits of the evacuation stairways or tall spaces should be calculated as not less than 1 meter per 100 people.

(6) Toilet requirements

Toilets for patients and medical staff shall be provided separately. Patients shall go through a dedicated closed passage, use temporary toilets, preferably mobile toilets with foam block type. Toilets for men shall be configured as one per 20 people, for women one per 10 people, which can be increased according to the actual needs of patients. Toilets should be located downwind of the building and as far away from dining and water supply area as possible. Feces from temporary toilets should be disinfected or centralized treated, arranged by professional personnel, 2 times per day, in accordance with the requirements of infectious disease hospitals. Direct drainage is strictly prohibited. The permanent toilets or restrooms could be used for healthy healthcare workers.

(7) Accessible design

For main entrance and exit, and hallway throughout the hospital, there shall be easy access to any medical department. The slope of the internal passage of the building should be connected by ramps, and the slope should meet the requirements of barrier-free and ensure the necessary width for mobile beds and accompanying staff to pass.

(8) Facilities and auxiliary rooms

For patient entrance to the hospital, there shall be storage rooms for personal belongings, disinfection area, and security check area, locker rooms for men and women. Exits for patient transfer and discharge shall include disinfection and packing areas.

In addition, there shall be observation rooms, emergency treatment and care rooms, food preparation rooms, bedding rooms and laundry, boiler rooms, cleaning rooms, and temporary garbage area. In the medical staff area, there can be pharmacy and medicine storage, clean rooms, offices and other.

3. Fire protection requirements

(1) If existing fire-control facilities and equipment can be used normally, emergency evacuation lighting shall be functioning normally. The ground area evacuation indication signs on the floor shall be clearly visible, and all exits shall meet the requirements of safety and remain unblocked.

(2) Corresponding number of fire extinguishers shall be provided in the building and shall be equipped in accordance with the current *National Standard Code for Fire Extinguishers (GB 50140—2005)*.

(3) Gas fire extinguisher shall be installed in the rooms for valuable equipment, medical records and the information center computer rooms.

(4) If there is water supply system inside FC hospital, and the fire hose reel is not equipped in the original building, a fire hose reel or a portable fire hydrant which can reach to any corner of the floor may be needed.

(5) A filter-like fire-fighting self-rescue respirator is provided for medical staff, and it can be placed in an easy-to-spot and easy-to-take place in the hospital.

(6) A nurse station should be equipped with a mini fire station, and the mobile high-pressure water storage capacity should be 100 liters.

(7) If condition permits, automatic fire alarm and fire control system should be operational.

4. Water supply and drainage requirements

(1) Treatment of sewage and waste water

Waste water from temporary mobile toilets and shower areas must be disinfected and treated, to meet the requirements from Ministry of Ecology and Environment of PRC. on *Emergency Technical Solutions to Novel Coronavirus Contaminated Medical Waste Water*. Feces, vomit, sewage and waste water from patient wards shall be disinfected. Do not

discard and dump infectious waste and various liquid waste into the sewer. Hospital air-conditioning condensate should be collected by districts, and treated with sewage from each district according to *General Guideline of Disinfection (GB19193—2015)* . Sewage shall be treated in accordance with the *Technical Guidelines for Sewage Treatment in Hospitals (2017 Edition)*, and the quality of treated water shall meet the criteria according to the standard GB18466—2005.

(2) Water supply system

Water supply system should be water tank water supply with pump and with cutoff switch, and with sterilization device. If condition not allowed, risk level of potential back-flow pollution should be evaluated according to the provisions of the *Standard for Building Design of Water Supply and Drainage (GB 50015—2019)* . Following requirements shall be met:

1) When the risk of backflow pollution is low and the water supply pressure meets the requirements, the water supply system should use a pressure-reducing backflow preventer to prevent backflow contamination.

2) When the risk is high, the water supply should have cutoff switch.

3) The water supply system in toilet and bathroom/shower area should have air-stop or backflow prevention device. Clean water supply shall have mechanism to prevent contamination with siphon back flow or back pressure backflow.

4) Water drainage and collection from temporary mobile toilet shall be separated from those in shower area.

5) Water drainage should be non-shrink, with dustproof seal. The vent on the drain pipe must not be connected to the exhaust duct of the air conditioning ventilation system.

6) Vehicle washing and disinfection wastewater should be drained to the sewage system, and drainage outlet with water seal. The depth of the water seal must not be less than 5 cm. It is strictly prohibited to use movable mechanical flaps to replace the water seal.

7) Do not use plugs in sink.

8) The drainage system shall adopt technical measures to prevent the damage of the water seal.

9) The drainage of the shower area should be collected in a sealed manner and let into the sewage system after disinfection.

10) The hot water in shower area should be from centralized supply system, and an air

source heat pump water heater should be used. Electric water heater shall be equipped with safety device.

11) Each ward should be supplied with a separate drinking water system, and the water supply should provide drinking water and hot water. The quality of water should comply with the *Sanitary Standards for Drinking Water* (GB5749—2006). Bottled water dispensers can also be used.

12) Water from the shower area should be drained into the sewage system after disinfection.

5. Ventilation requirements

(1) Contaminated dirty area and semi-dirty area shall mainly use natural air or mechanical ventilation. Air conditioning system should turn on air purifying and disinfection apparatus. Clean area with small space can use natural air or mechanical ventilation.

(2) If possible, the air conditioning unit shall be equipped with a clean air conditioning system with efficient air filter or air purifier; ultraviolet disinfection lamp can be installed near the return air filter.

(3) Medical area and patient ward area shall be ventilated through temporary air intake and exhaust, air flow from the medical area toward patient ward area in a reasonable way.

(4) When the existing air conditioners and ventilation systems can be used, DC transmission and exhaust air duct systems shall be considered. With air conditioning with return air valve turned-off, the new air valve can be fully opened. Fresh air into the exhaust volume should be larger than supply air volume. When the exhaust air volume is not enough, the smoke fan can be turned on. Medium to high efficiency filter can be installed at the entrance of the exhaust fan. If the original air conditioner and exhaust system cannot be used or there is no ventilation system, a ventilation system shall be added. When a temporary exhaust system is added, it is advisable to select those with appropriate air volume and pressure, the height less than 2 meters, and with protective measures. The ventilation system requires 24 hour uninterrupted operation.

(5) Exhaust volume should be not less than 150 m^3/h per person by design.

(6) After "First donning room — second donning room — buffer room", medical staff can move from clean area to the ward, the contaminated area. In first donning room, air supply shall be set to be>30 times/h, adjacent compartments with D300 short ventilation pipe, air flow

from clean area to ward area. The exit passage used by medical personnel shall be set to be >30 times/h, and adjacent compartment with a D300 short ventilation pipe, and the air flows from the clean area to the contaminated area.

(7) In each ward region, air filter with disinfection function shall be provided, and certain oil heater if necessary.

(8) Emergency dry toilets should be used in the patient ward area. Exhaust fans should be added to the toilets in the ward and in the medical staff area to meet the air change frequency of 12 times/h. Filter with high efficiency should be installed at the inlet of the exhaust fan.

(9) The location of the fan and exhaust system should be selected according to the actual situation. It should be ensured that the fresh air is taken from the outside. The fresh air outlet and the surrounding environment must be clean to ensure that the fresh air is clean. The outdoor exhaust should be installed high, and the horizontal distance from any air inlet should be>20 meters, and the vertical distance should be>6 meters.

(10) Ventilator alarm and signal shall be monitored in real time, to ensure the normal operation of the fan. The air filter system, exhaust air volume, and air supply, need to be checked and to be replaced timely if clogging occurs.

(11) Self-protection is required to replace of exhaust HEPA filter. Only designated and trained personnel can remove, disinfect, and dispose exhaust filter in the secure container, together with other medical waste.

6. Electrical and intelligent management requirements

(1) After conversion or reconstruction, electric power supply shall meet the power demand of the load, and the additional power lines should meet the required protection sensitivity.

(2) The distribution electric box and control box shall be located outside the dirty area, and should be placed in a special room when conditions permit.

(3) The ventilation equipment control box should be packaged in a complete set of products and be controlled centrally by the nurse station or duty room.

(4) When conditions permit, each bed should be equipped with 1–2 220V, 10A single outlets and lamps. If conditions is not available, multiple sets of single-outlet electrical box in large extension, can be used for patients to charge cell phones. When a electric blanket

is needed, the electric power supply should be equipped with a separate power circuit, with centralized and separate timing control to reduce the risk of fire.

(5) When conditions permit, more lighting fixtures could be installed on the surrounding wall of the large room, or free-standing floor lights on the ground, with opaque cover or indirect lighting to reduce the glare from the ceiling of the building.

(6) Lighting and socket circuits should use 30 mA residual current protectors.

(7) Wireless network access should be provided to ensure full coverage of 4G or 5G networks. Where conditions permit, wireless APs should be added to achieve full Wi-Fi coverage.

(8) The additional floor lighting, power line outlets and current lines on the ground shall be laid with metal pipes or pipes with slots to avoid the passage or hallway for people and packages.

(9) In medical places and other places that need to be sterilized, ultraviolet (UV) germicidal lamps or air sterilizer sockets need to be installed. UV lamps should use special switches with clear signs. It should not be parallel or juxtaposed with regular lamp switches. If the place where people are gathered needs ultraviolet germicidal lamps, indirect lamps or lamps with adjustable angles should be used.

(10) The auxiliary electric equipment shall be provided in the medical equipment room, shower room or bathroom.

(11) A one-touch alarm button, with access to the hospital security system, shall be set in the nurse station or duty room.

(12) Patient ward areas and nurse stations could be covered by video surveillance.

(13) If the floor wiring cannot be implemented during reconstruction of electricity and intelligent system, wireless solution shall be considered.

(14) After conversion or reconstruction, information management system could be shared according to the requirements needed.

(Wenjuan Wu)

Chapter 3

Infection Control Management Plan

A Practical Handbook for Infection Control in Makeshift (*Fangcang*) Hospitals: Experience from Coronavirus Disease 2019 (COVID-19) Pandemic

The FC hospital to deal with COVID–19 is quite different from general field hospital, because COVID–19 is highly infectious and contagious. Requirements for environmental facilities, processes and activities for medical treatment and health protection, are extremely high. Although FC hospitals mostly deal with patients with mild symptoms, it is quite challenging to maintain control for centralized treatment of over thousand confirmed patients with average length of hospitalization over ten days. Many complicated risk factors such as medical treatment, security, food catering services, medical waste treatment, environmental disinfection, personnel in-and-out of ward or cabin, pose great challenges in patient management and hospital infection control. Successful management and prevention of infection in the FC hospital are the major tasks. The establishment of management system, training, and continuous supervision must be carried out in order to achieve the effective control of the hospital and ultimately control of COVID–19 pandemic.

1. Hospital infection control guideline

(1) Goals and objectives

Goals and objectives shall be reducing the risk of the spread of COVID–19 in FC hospital, standardizing the behavior of all hospital staff including medical staff, and ultimately infection prevention.

(2) Organizational structure

There shall be a hospital infection control committee (ICC), consisting of the hospital director or chief medical officer, section chief representatives from medical or nursing units, infection control, support or logistics. The hospital ICC is responsible for examining and approving various systems of hospital infection management, and discussing and making decisions on major initiatives. Related working group can be set up by the hospital leadership and director of the hospital infection control.

(3) Duties of the hospital infection control committee or working group

In order to ensure the health of all personnel during medical diagnosis and treatment, avoid occupational exposure, control and prevent infection, the hospital staff of each team

shall arrange duty shifts, checks in and out on time, and daily reports or summary. Scope of daily hospital inspections should include all areas of FC hospital, locker rooms, entrances and exits, wards, general laboratories, imaging areas, BSL–3 (P3) laboratories, contaminated areas outside the cabin, and medical waste disposal areas. The main tasks are personal protection, disinfection and occupational exposure management. The details are listed as follows:

1) Guide the entrance and exit process, item setting, material allocation, medical waste and sewage treatment.

2) Responsible for infection control training of all medical personnel including imaging, laboratory, donning and doffing of personal protective equipment (PPE) correctly.

3) Daily inspection of the environmental sanitation and disinfection in the clean area, including locker room, personal protection materials, and the frequency of disinfection to meet the requirements.

4) Supervise nurses to clean up the medical waste in the buffer room in time, ensure the supply of disinfection supplies such as hand wash or wipes, and protective supplies such as gloves and masks.

5) Contact the head nurse of each ward to monitor the cleaning and disinfection of medical supplies, such as computers, tables and chairs, to ensure the timely removal of medical waste, and to keep patient toilets and shower rooms clean.

6) Find and deal with occupational exposure in time.

7) Provide guidance on laboratory, CT and P3 lab oratory and related connection with patient ward, and make sure procedures for specimen transport, patient transfer, and discharge meet the requirements of infection control.

8) Keep in touch with the security command center and report any emergency situation immediately.

2. Hospital infection prevention and control operating procedures

(1) Zoning environmental sanitation management

1) Dirty/Contaminated area

a. For surrounding environment, floor, and surface of the patient belongings, use 2,000 mg/L chlorine containing disinfectant (effect lasts > 30 minutes), soak, spray or scrub, effect last>30 minutes, at least 4 times/d, increased if necessary.

b. For office supplies, per shift disinfect or wipe with disinfectant wipes (75%

alcohol or 1,000 mg/L with chlorine) on the surface of medical personnel office desks and computers, at least 4 times/d.

c. For medical waste, clean up medical waste in ward at least 2 times/d.

2) Outside the dirty area

a. Overall requirements: maintain hygiene and tidiness, clean the surrounding environment at least 2 times/d;

b. Excreta, vomit, and secretions from patients: ① The excreta shall be routinely dumped; ② If the floor is contaminated with blood, vomit, excreta, etc., put an 2,000 mg/L chlorine-containing disinfectant on the contaminated floor, then clean with mop; soak mop with 500 mg/L of chlorine disinfectant for 30 minutes, clean and dry.

c. Medical waste and waste from patients: use double-layered yellow garbage bags, close the bag. Clean up and dispose wastes at least once a day.

3) Buffer room

a. Floor: spray or wipe the floor with 500 mg/L chlorine-containing disinfectant at least 2 times per day.

b. Surface: wipe surface of desk with 500 mg/L chlorine disinfectant or disinfecting wipes (75% alcohol or 500 mg/L chlorine) at least 2 times/d.

c. Medical waste: clean up medical waste around exit of the buffer room from medical staff 4 times/d, with recommended time around 7:00, 11:00, 17:00, and 23:00.

d. As there is no air circulation in the buffer room, and a plasma air sterilizer is needed for air disinfection.

4) Area for donning protective equipment

a. General requirements: maintain the area clean, and organize the overall environment and items every shift.

b. Floor: disinfect the floor using 500 mg/L chlorine containing disinfectant spray on the ground or use disinfectant wipe at least 2 times/d.

c. Air: after the medical staff change the protective equipment, open the windows and doors for ventilation, for 30 minutes each time.

5) Locker room

a. General requirements: maintain hygiene and tidiness, and clean the area at least 2 times/d.

b. Floor: spray with 500 mg/L chlorine disinfectant on the ground or with disinfectant wipe at least twice a day.

c. Eating: Regular eating in the locker room is prohibited.

6) Terminal disinfection

a. Disinfect surface of environment/floor/items: in the absence of obvious dirt or contaminants, spray or wipe the surface and floor with chlorine-containing disinfectant at concentration of 1,000 mg/L. When there are obvious contaminants or dirt, cover whole surface or floor with disposable absorbent material, spray to wet or soak with 5,000 ~ 10,000 mg/L chlorine-containing disinfectant for 30 minutes, and remove absorbent material.

b. Air clean and disinfect: disinfectants such as 3% hydrogen peroxide, 0.2% acetic acid peroxide or 500 mg/L chlorine dioxide can be used. Aerosol sprays, at concentration of 10–20 ml/m^3 (1 g/m^3), can be used. After 60 minutes of disinfection, exchange air with ventilation. Alternatively, heat fumigation with 15% acetic acid peroxide can be used, at concentration of 7 ml/m^3. After 1–2 hours of heat fumigation, exchange air with ventilation. Attention shall be paid to the height of the exhibition center and stadium with large air space, and choose the high-pressure aerosol spray equipment with the required spray range for large air space disinfection.

(2) Personnel and protective equipment

1) Ward

a. Medical staff: maintain the integrity of the protective equipment, avoid abrupt movements, and replace and change protective equipment immediately if it is damaged. If any occupational exposure occurs, handle the situation, report immediately, and exit ward with no delay.

b. Patients: use disposable mask for patients, prevent patients from gathering too close during activities.

2) Buffer room

a. Medical staff: in accordance with the principle of avoiding contamination, gently remove protective equipment.

b. Items: according to the actual usage, maintain sufficient gloves, quick-drying hand disinfectants and surgical masks at the exit (surgical mask is recommended to be placed in a sealable storage box with a lid, and marked).

3) Area for dressing/donning PPE

a. Maintain adequate amount of personal protective equipment (PPE) for each shift, and

the medical staff should replenish the supply in a timely manner; if short supply is noticed, contact the responsible person with no delay.

b. Donning PPE strictly in accordance with the required procedures, inspect and double check using mirror, especially air tight check when wearing a mask.

(3) Management of dirty or contaminated materials

a. After using by medical personnel, disposable protective clothing, masks, gloves, shoe covers, shall be disposed as medical waste of infectious diseases and incinerated.

b. Disposable items and waste used by patients in the ward shall be disposed in accordance with the medical waste of infectious diseases and incinerated.

c. Specimens for laboratory testing such as nasopharyngeal swabs, blood, stool, and waste generated from laboratory testing should be treated in the laboratory at 121℃ under high pressure for 15 minutes and treated as medical waste.

d. Reusable medical supplies such as goggles, protective face shields, etc. should be left in the 1,000 mg/L chlorine-containing disinfectant solution in the buffer room. After immersion in 1,000 mg/L chlorine disinfectant for minimum 30 minutes, goggles and face shield can be washed thoroughly, with no forced rubbed (the protective film on some brands of goggles may be damaged by rubbing). Test paper could be used for detecting remaining or leftover chlorine. Once dried, it can be taken out from the buffer room. Items could be put in a double-layer medical sealable waste bag, and delivered to a professional disinfection center for centralized cleaning and disinfection.

(4) Management of occupational exposure

a. All staff in FC hospital shall take their temperature before and after work, and report right away if temperature exceeds 37.3℃ .

b. If the protective equipment is damaged, and if there is no direct contact with the inner clothing and skin, wash hand, change and replace with a new PPE immediately. Doff and exit ward according to the protocol after work.

c. If skin, mucous membranes are exposed or damaged by sharp things, clean the skin immediately with iodine and 75% alcohol, or rinse eyes with saline. One shall report to the head nurse, and immediately doff and exit ward according to the protocol. Report the incident to leader in charge, and arrange self-quarantine or isolation for observation.

d. Personnel with occupational exposure, persons with no known occupational

exposure but have elevated body temperature or have suspected respiratory symptoms, should no longer work and need to be observed for 14 days in self-quarantine. During the quarantine, the person in charge will take care, and order CT and nucleic acid tests if necessary. Psychological counseling shall be offered during self-quarantine.

(5) Patient transfer

When a patient in a FC hospital needs to be transferred to other hospital for examination or hospitalization, the following requirements should be met.

a. Personal protection: drivers and on-board medical personnel should wear masks, protective clothing, goggles or face shields, long shoe covers or alternatives (such as thick plastic bags, rain boots), and double-layer medical gloves.

b. In car or ambulance: hand sanitizers, 1,000 mg/L chlorine containing spray, tissue paper, rags, etc., shall be supplied.

c. Before and after patient transfer, use 1,000 mg/L chlorine disinfectant to spray on the vehicle's interior, door, door handle and all possible contact areas.

d. After the delivery is completed, drivers and accompanying personnel shall use 1,000 mg/L chlorine disinfectant to spray on the body, and come back to work after 15 minutes. If no more work, remove the PPE according to the doffing procedure and exit.

3. Selection of personal protective equipment, donning and doffing procedures

(1) Personal protective equipment (PPE) requirements

Compared to general hospitals or hospitals for infectious diseases, staff working in FC hospitals is unique. In addition to the activities directly participated by doctors and nurses, there are police officers, housekeeping, and nucleic acid laboratory workers in the P3 laboratory. Therefore, the corresponding protective equipment requirements should be established in according to the biosafety risk level (see Table 3–1) .

(2) PPE Donning and doffing procedures:

1) Donning

Preparation: In the presence or supervision of a trained person, check all personal protective equipment for condition, intact and size that fits. Remove personal items such as

Table 3–1 Guidance on personal protective equipment for FC hospital staff

Duty	Protection grade	PPE	Mask	Other
1. Nucleic acid and blood test personnel 2. Sputum suction and respiratory tract sampling 3. Garbage removal/ terminal disinfection personnel and people who have a lot of contact with dirt such as feces, vomit, etc.	Level 3	1. GB19082—2009 2. EN14126	GB19083—2010(N95)	1. Isolation gowns 2. Goggles + face shields 3. Long shoe covers or alternatives (e.g. thick plastic bags, rain boots) 4. Double medical gloves 5. Garbage and excreta handlers need waterproof apron/long gloves/long rain boots/ splash screen
1. Doctor/CT 2. Non-sampling nurse 3. Work/Police/ maintenance support staff 4. Severe patient transfer staff	Level 2	1. EN 14605 type 3/type 4 2. ISO 13982—1&2 type 5	GB19083—2010(N95)	1. Isolation gown 2. Goggles or face shield 3. Long shoe covers or alternatives (such as thick plastic bags, rain boots) 4. Double medical gloves
Catering/drinking water carrier (do not enter the cabin) Specimen transshipment staff (do not enter the cabin) Medicine dispensers (do not enter the)	Level 1 (enhanced)*	Isolation or chemical protective clothing	GB19083—2010(N95) or medical surgical mask	1. Goggles 2. Gloves
Outside management staff	Level 1	Isolation or work clothes	Medical surgical mask	1. Gloves 2. Hat

* Although the catering/drinking water carrier, external specimen transfer personnel and medicine delivery personnel do not enter the cabin, they have handed over to the personnel receiving the goods in the cabin. In order to avoid accidents during operation, primary protection is set to protect the eyes and respiratory tract.

jewelry, watches, mobile phones, etc. Prepare your hair, take off your coat if necessary, and change work clothes, work shoes, or rubber boots.

Step 1: Hand wash (seven-step hand washing demonstration);

Step 2: Wear a medical N95 mask for air tightness check or fit test;

Step 3: Wear a disposable cap and inner shoe cover;

Step 4: Wear inner gloves (check glove air tightness); wear a gown when needed, and

the inner gloves wrap the cuffs of the gown;

Step 5: Wear protective clothing (protective clothing cuffs cover the inner glove cuffs, protective clothing trouser legs cover the outside of rubber boots);

Step 6: Wear outer gloves (cover the protective clothing cuffs);

Step 7: Wear goggles and/or face shield;

Step 8: Wear waterproof boot covers.

Observer shall assist in checking and confirming the donning process, ensure there is no bare hair, skin and clothing.

2) Doffing

Preparation: When removing personal protective equipment, a trained person must be present and supervise. Supervisors or monitors should wear PPE (at least including protective clothing or gowns, masks, face shields or protective glasses and gloves, etc.), and monitor doffing process. They should evaluate the contamination situation, according to the doffing order table, verbally remind each step, if necessary, can assist medical staff to remove equipment and timely disinfect hands.

Step 1: Wipe and disinfect when there are visible contaminants on the outer layer of personal protective equipment;

Step 2: Disinfect the outer gloves;

Step 3: Take off the waterproof boot covers and disinfect the outer gloves;

Step 4: Take off the goggles or face shield (lower your head and close your eyes, gently operate), disinfect the outer gloves;

Step 5: Untie the protective clothing adhesive and disinfect the outer gloves;

Step 6: Take off the protective clothing together with the outer gloves and disinfect the inner gloves;

Step 7: Take off the gown and inner shoe covers, and change work shoes or rubber boots when needed;

Step 8: Hand hygiene, remove the inner gloves;

Step 9: Remove the disposable cap, medical mask, and disinfect hand;

Step 10: Take off the work clothes and wash your hands with running water;

Step 11: If condition permits, change your personal clothing after showering.

Both observer and medical staff evaluate doffing process together. Disinfect skin and mucous membranes if contaminated or exposed in time, and report to hospital person in charge, and conduct quarantine and medical observation if necessary.

4. Specimen collection and transport

Specimen collection is recommended to be performed in a special sampling room outside the ward cabin, which area can be disinfected after sample collection. The nurses are required to have level 3 precaution practice, i.e., wear a face shield when collecting specimens.

(1) Collection of nasopharyngeal swab specimens and/or oropharyngeal swabs.

Because the need of pharynx to be viewed clearly, medical staff usually has to stand directly opposite the patient, and the risk of exposure is very high. For patients with COVID-19, sputum specimens and bronchoalveolar lavage fluid may not be collected. Nasopharyngeal swabs are specimen of choice.

1) When collecting nasopharyngeal swabs, it is not necessary for the collector to stand directly opposite the patient. Regardless of whether the patient is sitting or lying, the right-handed person can stand on the right side of the patient, and the left-handed person can stand on the left side for sampling operations. The advantage of standing on the side is that if the patient has coughs, sneezes, etc., the collector can avoid it in time.

2) Pass the nasopharyngeal swab through the nostril, it penetrates perpendicularly to the coronal surface of the head or the face, and penetrates from the lower nasal passage to the back wall of the nasopharynx. Insert nasopharyngeal swab to nasal cavity about a distance from the tip of the nose to the earlobe.

3) Twist the nasopharyngeal swab on the nasopharyngeal mucosa, stay for 10–15 seconds, and then remove the swab. As children may not cooperate well, after fully twisting 2 or 3 times, remove the swab in 3–5 seconds.

4) Note: It is wrong to let patient to fully raise head, bend the swabs, and then take sample. This operation will cause the swab head to incorrect location, and what obtained is not the standard nasopharyngeal specimen.

(2) Specimen Transport

1) After patient specimen collection, submit samples to P3 laboratory, general laboratory or reference laboratory, for nucleic acid amplification test, blood, hematology and chemistry testing.

2) Leave specimens collected in a closed sample shipping box or container for deliver or shipping. Spray exterior of box or container with 1,000 mg/L chlorine-containing disinfectant and wipe clean, and then transport by nurses or other staff to the specimen transfer point. When hand over sample, avoid direct contact, check the accuracy of information, and leave specimen into the transfer or shipping container. Spray again with 1,000 mg/L chlorine-containing disinfectant to the outer surface of the transfer or shipping container. Specimen transfer personnel in the contaminated area shall have level 2 precaution and protection.

5. Patient admission and discharge, and home quarantine

(1) Hospital admission management

1) Before 10:00 am every day, the person in charge of the patient zone (head nurse) should calculate the number of patients that can be admitted, report to the hospital director. Based on the availability of the beds, hospital administrators in charge can determine the number of patients to be admitted that day, and report to command center.

2) Based on the number of vacant beds provided by the FC hospital and the number of patients to be admitted, the command center can determine the number of patients transferred to FC hospital, and provide a list with basic information of the patients (including patient identification information, contact number, condition information, medication information, etc.) and send it to FC hospital.

3) The FC Hospital shall ask the medical expert team to review the patient information and conditions according to the admission criteria. Hospital can then determine the list of patients to be admitted and treated on the day, assign the wards and beds, and issue a transfer certificate for each patient and report it to the command center.

4) The command center or headquarter will print the information sheet of each patient (the patient number is written on it), and give it to each patient with certificate for transfer and admission.

5) The command center is responsible for coordinating patient transfer arrangements, and ambulance dispatch. The on-board personnel who accompany patients shall have level 2 protection, and patients wear disposable surgical masks and carry essential necessities.

6) Patients are required to wear disposable surgical masks during treatment in FC

hospital, pay attention to personal hygiene, and do not make loud noises or do strenuous exercises.

(2) Discharge management

1) Apply 1,000 mg/L effective chlorine spray to disinfect clothes, pants at the exit of the ward, step on foot pads containing chlorine disinfectant (2,000 mg/L), and clean hands with disinfectant.

2) The clothes and daily necessities changed or left by patients shall be treated as medical waste and incinerated and destroyed. For those who are unwilling, items can be disinfected by spraying with 1,000 mg/L of effective chlorine, packed in two-layer garbage bags, and given to patients to take home.

3) Provide one clean mask for each patient to be discharged, who can wear and go out of hospital, from the ward area to clean area. At the exit of the clean area, apply 1,000 mg/L effective chlorine spray to disinfect the clothes, pants, step on the foot pad containing chlorine disinfectant (2,000 mg/L), and clean hands with disinfectant.

4) Dispose used sheets, pillowcases, beddings (uncontaminated bedding can be disinfected, cleaned and reused in special cases) and other items as medical waste. Clean and disinfect the used mattresses, bedside tables, chairs, thermos bottles with 1,000 mg/L effective chlorine spray or wipe surface disinfection. Prepare new bedding and sheets for newly admitted patients.

(3) Home quarantine

During the home quarantine for 14 days, the temperature should be measured daily for 14 days. If there is no condition for home isolation, the commander center shall arrange centralized isolation. When the symptoms such as fever and cough reappear, or the original symptoms worsen, immediately report to the person in charge in the community and go to nearby designated hospital for treatment. Attention for isolation at home: wear a mask for isolation in a single room and try not to go outdoors.

6. Medical Team's living site management

In order to ensure the safety of all personnel in the living place and avoid cross-infection, in principle, it shall be one single room for one person. In special circumstances when two

people live in one room, two beds shall be over 1.5 meters in distance, and there shall be certain physical division. Medical team members in the public area of the station must wear masks, keep a distance between people, and do not gather for entertainment. Medical team members are not allowed to go to places such as supermarkets, and shall not gather in group.

(1) Station entrance

1) Self-disinfection, including hand hygiene, clothing, and shoes.

2) Measure the body temperature. If the body temperature exceeds 37.3℃ , register and report to the team leader in time. If there is no one at the inspection table, measure the body temperature with an infrared thermometer by yourself, report any abnormalities in time.

3) Those who work at night, please consciously complete the above operations by yourself.

(2) Elevator

1) Use tissue paper to press button of elevator.

2) Throw paper tissue into the trash can after reaching your floor.

3) Medical materials such as disposable surgical masks must not be disposed with the household garbage in the garbage bin near elevator. They should be collected and dispose accordingly.

(3) Get into door

1) Prepare hand cleaner, wet wipe, alcohol on the low cabinet near door, have trashcan near the door.

2) Disinfect small items such as mobile phones, glasses, keys, door cards and other items used.

3) Take off your hat, jacket or coat, pants and shoes, leave them outside the room door.

4) Take off the mask and throw it into the trash bin. Disinfect your hands using wet tissue and scrub your face. Use a cotton swab dipped in 75% alcohol to scrub the ear canals and nostrils.

5) Clean your hands, take small items and change clean slippers into the room.

(4) Inside the room

1) Keep room ventilated, clean and tidy. Disinfect regularly.

2) Use disposable tableware and dinning ware etc., which can be discarded into the

garbage bin after use. Wipe all countertops with disinfectant wipes.

3) Outdoor slippers cannot be worn indoors.

(5) Resident hall and public area

Lobby, public toilets, toilets, elevators, hallways, and other places, clean with 1,000 mg/L effective chlorine spray for disinfection at least 2 times/d. Note: Disinfection should be performed when nobody is around, so as to reduce the harm of disinfectant to people.

7. Medical waste management system

(1) Implement the responsibility and compliance. It is important to manage medical waste generated in the FC hospital, and effectively implement the corresponding responsibilities. The head of each division is the first person responsible for the management of medical waste, and the specific operator is the direct responsible person. All efforts for environmental sanitation shall be made to timely treat medical waste, avoid accumulation of various waste, and create a healthy and sanitary environment.

(2) All personnel responsible for medical waste disposal are subject to pre-service hospital infection control training and competence training, which include the use of protective equipment, disinfection technical specifications and relevant laws and regulations. Donning and doffing of protective equipment should be completed under the guidance and assistance of the staff on duty in the locker room and the dressing room.

(3) Infection control group shall be responsible for collection and disposal of medical waste, regular inspection of each unit, problem finding, feedback, supervision, and remedial action plan.

(4) Waste generated from all wards and divisions include medical waste and garbage should be classified as medical wastes.

(5) Specialized medical waste bags, as well as the sharps containers should have clear warning labels. Bags and containers should be carefully checked to ensure no damage and leak. The medical waste collection buckets should be foot-operated and covered. When medical waste reaches 3/4 of the packaging bag or sharps container, it should be sealed tight. Double-layer packaging bags should be used for medical waste, and gooseneck knots should be used to seal the waste in layers.

(6) Medical waste shall be collected timely according to category, to ensure staff safety,

reduce and control infection risk. When the outer surface of the packaging bag and sharps box containing medical waste is contaminated with infectious waste, a layer of packaging bag should be added. It is strictly prohibited to squeeze the disposable gown or clothing, PPE and other items after use. Each packaging bag and sharps container should be attached or affixed with labels, which indicate the ward or unit where medical waste was generated from, the date and type of production, and the special labels with COVID–19 or novel coronavirus pneumonia.

(7) Before taking potential contaminated medical waste out of contaminated area, clean the surface of the packaging bag with 1,000 mg/L of chlorine-containing disinfectant, evenly spray, or put on another layer of medical waste packaging bag. The medical waste generated in the clean area shall be disposed in accordance with general medical waste.

(8) Medical waste containing pathogens in specimens and hazardous waste associated toxic solution, such as nucleic acid testing, blood samples should be autoclaved or chemically disinfected inside the laboratory. Afterward, follow the general infectious waste disposal method.

(9) Transport and storage of medical waste

1) Safe transportation: Before transporting medical waste, check whether the identification, label and sealing of the packaging bag or sharp container meet the requirements. When transporting medical waste, workers should prevent damage to the special packaging bags and sharps containers for medical waste, prevent direct contact of medical waste with the body, and prevent leakage and spread of medical waste. After the delivery, clean and disinfect the delivery tools using chlorine-containing disinfectant solution at 1,000 mg/L.

2) Storage: The temporary storage place for medical waste should have strict closure measures, and staff should prevent non-workers from contacting medical waste. Medical waste should be stored in a separate area in the temporary storage area, and handed over to the medical waste disposal unit for disposal as soon as possible. The floor of medical waste storage area shall be disinfected using 1,000 mg/L chlorine-containing disinfectant twice a day. The personnel from medical department, transportation, temporary storage, and medical waste disposal unit should document and track if waste originated from confirmed or suspected patients with COVID–19.

3) Documentation: The protocol for dealing with hazardous waste transfer shall be

strictly implemented. The registration includes the source, type, weight or quantity of medical waste, transfer time, final destination and signature of the operator, with special indication of COVID–19. Documents could be kept up to 3 years.

4) Timely inform the medical waste disposal unit to collect the medical waste on site or build its own treatment point, and make corresponding records. Health administrative departments and hospitals should keep information exchange at all levels with many departments for handling medical waste during COVID–19 pandemic.

(Wenjuan Wu Guixin Sun)

Chapter 4

Case Study of Key Scenarios

1. Selection of personal protective equipment (PPE), donning and doffing

Personal protective equipment (PPE) is an important safety protection for medical staff in treating infectious diseases, especially with high risk of transmission, and transmission routes are unknown. Protective clothing can prevent all kinds of secretions, sprays, and particles that may carry pathogens protecting the health and safety of medical workers, and is an important protective measure against the pandemic of COVID–19. Therefore, the correct choice of protective clothing and the proper donning and doffing procedure are particularly important. All personnel who come into contact with the patients, i.e., security, environmental services, food service personnel and others, must have training and support.

(1) Scenario description

On February 23, 2020, the hospital inspectors found that in the locker room, cleaning and security personnel were wearing protective clothing in the locker room, and the protective clothing appeared to be stretched and damaged on the shoulders and hips (Figure 4–1) .

Figure 4–1 The protective clothing appeared to be stretched and damaged

(2) Severity and scope of impact

When security, housekeeping, cleaning personnel, and even reporters, enter the FC hospital, the protection level is the same as that for the provider staff: level 2 protection. The tightness of the protective clothing when squatting or raising the arms can cause direct or indirect safety hazards and may put the workers at risk for contamination. The waist of some protective clothing is too tight, which will restrict the movement of workers and affect their work. In particular, the tightness of the protective clothing will cause improper tension on the fabric and seams, which will easily cause protective clothing to tear, potential increase the risk of virus exposure.

(3) Cause analysis

The tightness of the protective clothing on the shoulders, hips, and other parts is caused by the wrong selection of the protective clothing size. The size of protective clothing is usually divided into five standard sizes: S, M, L, XL and XXL. Choose protective clothing that is not fit or too small, especially when there are operations such as raising arms, bending over, squatting and other work, will potentially cause the protective clothing tension stretch or even tear.

(4) Suggestions and basis for rectification

A proper size of protective clothing avoids tight stretching or even breakage and tearing in the job, allowing workers to be comfortable and secure enough. First, you need to choose the right size of PPE. The following step is to get correct size (or the right size of your own body), mainly by wearing protective clothing to confirm the appropriate size.

1) Check the validity and integrity of the protective clothing.

2) Select the size of protective clothing according to the product size and selection table (Table 4–1) .

Table 4–1 Protective clothing size and selection

Ready-to-wear size	Height (cm)	Bust (cm)
S	164–170	84–92
M	170–176	92–100
L	176–182	100–108
XL	182–188	108–116
XXL	188–194	116–124
Depending on the user's height and bust, follow the chart above to select the appropriate size.		

3) After wearing the protective clothing, move head and check if the protective clothing still comfortable.

4) Does the design guarantee sufficient movement space?

5) Protective clothing can easily fit with protective gloves, respirator or work shoes?

6) Is the zipper smooth, i.e., not blocking and allow free movement?

7) When wearing the protective clothing, Can you comfortably perform the following three actions (Figure 4–2) : raise arms, bend over, and squat? check whether the PPE selected properly fits and donning is correct.

Figure 4–2 raise arms, bend over, and squat

(5) Evaluation of rectification effects

Through multi-level and full-range training, non-medical staff such as security, housekeeping, and cleaning personnel will feel comfortable about the selection of protective clothing and procedures for donning and doffing, Unit nurses can supervise and check protective clothing for wear and tear.

(6) Selection criteria for protective clothing (PPE)

Medical protective clothing shall have the following standards.

1) Surface moisture resistance: The liquid barrier level of the protective clothing should not be lower than the level 3 requirements in GB/T 4745—1997.

2) Breaking strength: The breaking strength of the PPE sample should be>45N.

3) Elongation at break: The elongation at break of the PPE sample is>30%.

4) Filtration efficiency: The filtering efficiency of PPE for non-oily particles is>70%

5) Flame retardant: Protective clothing with flame retardant properties shall meet the requirements of Class B2 in GB 17591—1998.

6) Antistatic: Charge of PPE should be<0.6 μC.

7) Skin irritation: The material of PPE must not cause skin irritation.

8) Microbiological indicators: PPE should meet the requirements of GB 19082—2009 for microbiological indicators. PPE should be marked with the words "sterilized" or "sterile" on the packaging or shown on the diagram should be sterile.

(7) About medical protective equipment from overseas

Protective clothing for emergency medical supplies should meet the European Union's medical protective clothing EN14126 standard (where the liquid barrier level is above level 2) and obtain the European CE certification, or liquid dense protective clothing (type 3, in accordance with EN 14605) , spray dense protective clothing (type4, conforming to EN 14605) , protective clothing against solid particles (type5, conforming to ISO 13982—1 & 2) . Emergency medical supplies protective clothing is used only in observation or transition wards, or in isolation rooms, and cannot be used in wards with strict biological control, such as ICUs.

Chemical protective clothing that meets the standards of grades 3 and 4 can be used in the clinic, and products of other levels of chemical protection and labor protection cannot be used in the clinic. So we should inform what would be worn in the ICU.

2. Protection goggles: wear and clean

Goggles are products that prevent infectious substances, such as blood and body fluids, from splashing into the eyes. During the pandemic of COVID-19, they have been used in FC hospital wards. Goggles are useful during operations involving risk of splashing from blood, body fluids, and secretions, i.e., collection of respiratory specimens, nebulization treatment, sputum suction, and oxygen absorption. If the goggles are reusable, they should be disinfected and dried in a timely manner for future use. Have a plan for this disinfection whether it is alcohol, bleach or sterilization.

(1) Scenario description

1) In the process of donning PPE, should medical staff entering the ward area don

Figure 4–3 The goggles fogged heavily(the left one)

goggles first and then protective clothing, or protective clothing first and then protective goggles? when both conditions exist in clinical practice, which one is preferable?

2) When the medical staff wore the goggles, the goggles fogged heavily (Figure 4–3).

3) When removing PPE, medical personnel and work personnel remove the goggles incorrectly.

Figure 4–4 Goggles soaking

4) The cleaning and disinfection of reusable goggles maybe incorrect (Figure 4–4).

(2) Severity and scope of impact

1) The order of donning goggles and protective clothing is incorrect, affecting the protective effect.

2) Incorrect removal method of goggles may increase the contamination of exposed parts of hands and face.

3) Goggles fogging, may seriously affect the range of vision, thus affecting process of clinical practice and treatment.

4) If non-disposable goggles were thrown away, it would be a waste of valuable resources.

5) If the process of cleaning and disinfection of reusable goggles is incorrect, it would potentially pose a risk to the safety of medical personnel.

(3) Cause analysis

1) Don goggles first and then wear protective clothing. The main consideration is the order of doffing, i.e., wearing goggles first during donning and removing last in doffing. During the process of removing PPE, a large amount of aerosol may be generated, and goggles can protect the eyes from exposure to aerosol.

2) Don PPE and then wear goggles. The main consideration is the sealing tightness around the head. Wearing PPE before goggles can maximize the sealing of the head, especially the face, and reduce the circulation of between the head and outside air.

3) The fogging of goggles is mainly due to the poor air sealing of the mask. The exhaled gas diffuses from the top of the mask into the goggles and condenses into the liquid from the top of the mask, causing the goggles to fog.

4) The method of removing goggles is incorrect. Personnel may not take the step of removing goggles seriously.

5) Reusable goggles are removed and thrown into the medical waste bucket: The removal of protective equipment is an integral and continuous action. Almost all items are regarded as medical waste. Due to the inertia of thinking, the removed goggles are discarded as medical waste in the medical waste bucket at will.

6) For reusable goggles, if the concentration of disinfection solution is not right, and the rinse process is not sufficient, there may be residual disinfection solution left on the goggles. In addition, the disinfection solution should cover the soaking goggles, using a covered disinfection container; After soaking and disinfection in the buffer room, rinse and dry goggles outside the buffer room.

(4) Suggestions and basis for rectification

1) The correct donning sequence, according to the "Hospital Isolation Technical Specifications" and "Technical Guide for the Prevention and Control of New Coronavirus Infection in Medical Institutions (1st Ed.)", in the process of putting on and taking off protective equipment is to don PPE before goggles. It is recommended that during doffing, eyes should be kept closed when removing goggles to minimize eye exposure. In addition, for operations such as specimen collection, if using a protective face shield, you can choose

to wear goggles first and then PPE.

2) For the fogging of goggles, the best method is to wear anti-fog goggles, but if available goggles are not the anti-fog type, the following methods can be adopted according to our experience. ① Apply hand sanitizer on the lens, rinse it with water, and dry it for later use; ② Apply the inner surface of the goggles evenly with detergent, and leave them to dry naturally; ③ Apply a thin layer of iodine solution to the inner surface of the goggles(Figure 4–5). It is advisable to choose a method that does not affect sight or stain the goggles.

3) The correct way to remove goggles is to slightly lower your head and close your eyes, hold the rear strap with both hands and gently remove the goggles from the back(Figure 4–6) .

4) Disinfecting and cleaning of reusable goggles. Using chlorine-containing disinfectant as an example, configure the effective chlorine 1,000 mg/L–2,000 mg/L chlorine-containing disinfectant to soak for at least 30 minutes, and then rinse it thoroughly. Use a chlorine

Figure 4–5 Apply a thin layer of iodine solution to the inner surface of the goggles

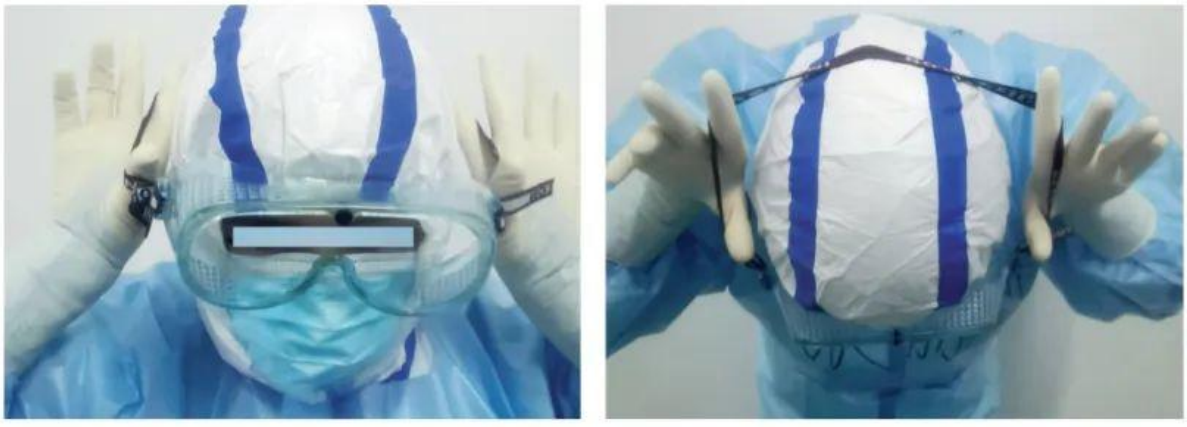

Figure 4–6 Specification steps for removing goggles

concentration test strip to detect residual chlorine concentration, which must be lower than the lowest limit. Dry naturally or use drying equipment (temperature: 65℃ –75℃).

(5) Evaluation of rectification effects

1) After donning protective clothing, don goggles to improve face protection.

2) Before wearing the goggles, routinely treat the lenses with iodophor or hand sanitizer, and there will be no fog when wearing the goggles.

3) Remove the goggles strictly according to the standard steps, making the removal process safer.

4) For reusable goggles, enact reasonable disinfection (Figure 4–7) and rinsing tests, and then reuse goggles after drying.

Figure 4–7 Clean and disinfect the goggles after removal

3. Masks: selection and wear

Masks are an important tool for preventing respiratory infections and can reduce the risk of new coronavirus infections. The mask can not only prevent the patient from spraying droplets and reduce the droplet volume and spraying speed, but also block the virus-

containing droplet core and prevent the staff from inhaling it.

(1) Scenario description

When wearing double medical surgical masks, the nose clip is not shaped properly and does not fit the face completely (Figure 4–8).

Figure 4–8 The wrong way to wear double surgical masks

(2) Severity and scope of impact

When staff enters the ward to work or makes contact with infected patients, there is a risk of exposure.

(3) Cause analysis

If any mask does not fully fit the face, it will lose its protective filtering function of the mask. Wearing a double surgical mask does not increase protection.

(4) Suggestions and basis for rectification

The correct way to wear a face mask: Perform hand washing or hygiene before donning a face mask, with the dark side of the mask facing outwards and the metal nose clip facing up. The upper strap of the mask is tied to the top of the head, the lower strap is tied to the neck, and the mask is deployed so that the mask completely covers the nose and jaw.

Forefinger and middle finger of both hands are brought together, and the center of the metal nose clip is pressed gradually to the sides to shape the mask so that the mask is close to the face. If you are wearing a medical protective mask such as N95, perform an air tightness check or (fit test): cover the protective mask with both hands, exhale quickly, and check for leaks near the nose clip. If air leaks at the nose clip, adjust the plastic nose clip again; if air leaks around the mask, adjust the mask until there is no air leak.

(5) Evaluation of rectification effects

Wear disposable surgical masks in the clean area, and wear medical protective masks or non-respiratory valve N95/KN95 masks in the contaminated area. The masks should fit the face completely, and the shape of the nose clip should fit closely, with good air sealing.

(6) Mask selection and technical instruction

In order to guide different populations to choose and use masks scientifically and reasonably to prevent the COVID–19 spread, the "Technical Guidelines for the Selection and Use of Masks for Preventing COVID–19 among Different Populations" according to the nature and risk level of the pandemic prevention work, select for suitable mask types, and the following guidelines are suggested.

1) Persons at highest risk for exposure

a. Personnel category

a) All staff working in the ward, ICU, and observation rooms for patients with COVID–19 (confirmed cases and suspected cases), including clinicians, nurses, cleaners, cadavers, etc. ;

b) Doctors and nurses who work in designated medical institutions or clinics in the pandemic area;

c) Public health physicians conducting epidemiological investigations on confirmed and suspected cases.

b. Protection suggestions

a) Medical protective masks;

b) Wear protective goggles or face shields during first aid and intubation and bronchoscopy of infected patients;

c) In case of shortage of medical protective masks, you can choose to replace them with N95/KN95 and above standard particulate matter protective masks, or you can choose self-priming filter respirators (full or half face type) with cotton filter to prevent particulate matter. Protective effect of power supply air filter respirators is better.

2) Persons with the second-highest risk for exposure

a. Personnel category

a) Clinical staff in emergency department;

b) Public health physicians conducting epidemiological investigations on close contacts;

c) Personnel testing Environmental and biological samples related to the pandemic.

b. Protection recommendations: Particulate protection masks that meet N95/KN95 and above standards;

3) Persons at medium-risk

a. Personnel category

a) Clinical staff working in general outpatient settings and wards, etc.;

b) Staff in densely populated places, including those in hospitals, airports, railway stations, subways, ground buses, planes, trains, supermarkets, restaurants, etc.

c) Persons engaged in administrative management, police, security, courier and other practitioners related to the pandemic situation;

d) Persons living in isolation and those living with them.

b. Protective suggestions: Wear medical surgical masks.

4) People with lower risk for exposure

a. Personnel category

a) The public in densely populated areas such as supermarkets, shopping malls, transportation, elevators;

b) Workers in indoor office environments;

c) Patients seen by medical poviders (except for as above);

d) Children in childcare institutions and students in schools, etc. who focus on learning and activities.

b. Protection recommendations: Wear disposable medical masks (children choose products with equivalent performance).

5) persons at Low-risk for exposure

a. Personnel category

a) The public engaging in indoor activities at home or in areas with scattered residents;

b) Outdoor activists, including children and students in open areas/sites;

c) Workers in a well-ventilated workplace.

b. Protection suggestions: Masks may not need to be worn in homes, or well-ventilated and low-density places. Non-medical masks, such as cotton gauze, activated carbon, and sponges, have certain protective effects, and can also reduce the spread of droplets caused by coughing, sneezing and talking. However, people are advised to maintain a distance of more than one meter between one another and not to gather.

6) Change masks: Medical standard protective masks have a limited time for use, and the masks are for exclusive use. They cannot be used cross-personally. Medical protective masks need to be replaced after high-risk personnel taking off protective devices after work, eating or drinking, entering the toilet, etc.; masks should be replaced immediately if contaminated by patients' blood, respiratory/nasal secretions, and other body fluids contamination; Medical protective masks need to be replaced after contact with patients with highly suspected infection.

4. Environmental surface and air disinfection

Disinfectant is a preparation used to kill microorganisms to meet the requirements of disinfection or sterilization. There are many types of disinfectants, which can be divided into alcohol disinfectants, chlorine disinfectants, iodine disinfectants, peroxide disinfectants, guanidine disinfectants, phenol disinfectants, and quaternary ammonium disinfectants.

According to the purpose of use, disinfectants can be categorized into object surface disinfectants, medical device disinfectants, air disinfectants, hand disinfectants, skin disinfectants, mucosal disinfectants, epidemic disinfectants, etc.; According to the ability to kill microorganisms, they can be divided into high-level disinfectants, medium-level disinfectants, and low-level disinfectants.

(1) Scenario description

1) The working hours of the FC hospital are two 8–hour shifts, with the peak hours beginning in the ward at 8 am. At 7:50 in the morning, when many doctors were preparing to work in the locker room, environmental workers sprayed with 1,000 mg/L of chlorine-containing disinfectant (Figure 4–9) .

Figure 4–9 Spray effective chlorine to kill in dressing room, causing skin damage

2) Alcohol-containing rapid hand disinfectants have an ethanol concentration of less than 60%, which does not meet the requirements for disinfection.

(2) Severity and scope of impact

1) The chlorine-containing agent has a strong oxidizing effect. If it comes into contact with the epidermal skin, it will cause skin burns, a burning sensation and epidermal peeling. If accidentally splashed into the eye or inhaled, it will cause different degrees of mucosal damage and burning and damage to the conjunctiva, nasal mucosa and oral mucosa. Chlorine-containing disinfectants can cause varying degrees of harm to the human body if not applied properly.

2) Hand sanitizers with an alcohol concentration of less than 60% are not effective against 2019–nCoV. Some compound hand disinfectants have an ethanol concentration of only about 50%, which can kill common bacteria. However, it is not work in 2019–nCoV.

(3) Suggestions and basis for rectification

The 2019–nCoV is sensitive to ultraviolet rays and heat. For 30 minutes at 56℃, disinfectants such as chlorine-containing disinfectants, 75% ethanol, and peracetic acid can effectively kill the virus.

Disinfectants should be used reasonably, follow the "5–must and 7–no", and truly cut off the transmission route and control the epidemic of infectious diseases.

1) The Five-must (5–must) is list as following:

a. In the isolation ward and patient's residence, perform random and terminal disinfection at any time.

b. Increase the frequency of disinfection on the surfaces of environmental objects in densely populated places such as hospitals, airports, and stations.

c. Clean and disinfect high-use door knobs or handles, elevator buttons, etc.

d. Collect and treat garbage, feces, and sewage.

e. Emphasize personal hand hygiene.

2) The Seven-no (7–no) is as follows:

a. Disinfectant use is not suitable for large-scale outdoor environmental disinfection;

b. Disinfectant use is not suitable for environmental air disinfection;

c. It is not suitable to use chemical disinfectants or powder directly on human;

d. It is not suitable to use disinfectant (powder) to disinfect personnel directly;

e. It is not advisable to add disinfectants (powder) to disinfect ponds, reservoirs,

artificial lakes, etc.;

f. Glutaraldehyde should not be used for wipe and spray environmental disinfection;

g. High-concentration chlorine-containing disinfectants (effective chlorine concentrations over 1000 mg/L) are unsuitable for preventive disinfection.

(4) Evaluation of rectification effects

1) The working hours of environmental disinfection workers should not overlap with the entry and exit times of care personnel to avoid damage to human bodies.

2) Use 75% medical alcohol to clean hands or objects to ensure the safety of medical, work, police and security, and other staff.

5. Classification and disposal of medical waste

(1) Scenario description

1) Environmental sanitation personnel did not transfer the garbage in accordance with the required route, from the contaminated area, wearing protective clothing through the peripheral area of the hospital to the clean area and transferring medical waste to the car.

Figure 4–10 Discarded protective clothing is not properly wrapped

2) In a contaminated area outside a ward, the used PPE was directly discarded in a non-medical waste bin and was not bandaged (Figure 4–10) .

(2) Severity and scope of impact

1) There is no effective physical barrier to separate the contaminated medical waste from the clean area, and people and transfer vehicles can pass easily. Once contaminated material leaks, it may likely cause infection of workers.

2) Contaminated protective clothing is directly exposed to the air, causing contamination to the surrounding environment, even in the contaminated area. At the same time, there may also be a risk of infection for staff who collect medical waste.

(3) Suggestions and basis for rectification

1) A physical barrier should be set up to strictly separate the contaminated area from

the clean area and clearly identify it. Clearly define the transportation path of contaminated materials and train environmental workers to implement it.

2) Collect according to the type of medical waste to ensure personnel safety and control the risk of infection. It is strictly forbidden to squeeze the disposable isolation clothing, protective clothing and other items after use. Before leaving the contaminated area, medical waste generated from the contaminated area should be sterilized by spraying the surface of the packaging bag with 1,000 mg/L of chlorine-containing disinfectant, and one more medical waste packaging bag should be placed on the outside and sealed tightly. Packaging bags and sharp boxes should be labeled. The medical waste generated in the clean area is disposed of as regular medical waste. All medical waste is incinerated.

(4) Evaluation of rectification effects

1) The contaminated area is completely isolated with a barbed wire rack. After physical isolation, environmental workers cannot directly pass through to the clean area (Figure 4–11) . There was no more transportation contaminated-medical waste situation. The overall rectification results were effective.

2) After the training, the nurses collected all the garbage in the ward was collected by the nurses, using two layers of yellow medical waste bags, then sealed and transported the waste to the temporary medical waste storage point outside the ward. Environmental workers collected waste twice a day and transported it to the incineration station for garbage disposal.

Figure 4–11 Effective physical isolation barriers

(Zhiyuan Zhang Wenjuan Wu)

Appendix

Occupational protection surveys for Staffs and Employees in FC Hospitals

Dear Colleagues,

Thank you for completing these anonymous surveys. These surveys are used to analyze your infection control experiences in this COVID−19 pandemic to provide theoretical support for future reference. Much appreciated!

1. Basic Information

1. The name of your residential hospital _____
2. The name of your FC hospital _____
3. The ranking of your residential hospital _____
4. Age _____
5. Gender _____
6. Ethnicity _____
7. Working department _____
8. How many years have you been working _____
9. Highest Educational Degree _____
10. Occupation in your residential hospital _____
11. Number of days to participate in anti COVID−19 so far _____

2. Infection Control Questionnaire 1

1. Previous experience with medical rescue _____
2. Occupation in FC hospital _____
3. How well do you know proper procedures for wearing masks _____

4. Types of mask you wear daily _____
5. Did you wear multiple masks _____
6. If wearing multiple masks, what type _____
   a. Disposable medical masks
   b. Medical surgical masks
   c. Particulate protection masks
   d. Medical protective masks
7. Average wear time per mask _____
8. How many times per week do you enter the inpatient area _____
9. Number of days you have been in the FC hospital so far _____

For staffs entering the inpatient areas only

10. Training experience before entering _____
11. Have you felt discomfort during shifts _____
12. Have you ever felt that the air was contaminated or the temperature wasn't ideal

    _____
13. Have you experienced occupational exposure while working in inpatient area

    _____
14. If so, what kind of occupational exposure did you experience _____
    a. Dropped mask
    b. Damaged protective suit
    c. Damaged shoe covers and shoes
    d. Damaged gloves
    e. Exposure when taking off PPE
    f. Needle stick injury
    g. Exposed to secretions without facial protection
    h. Others
15. Type of shoes you were wearing in inpatient area _____
16. To what extent did the protective gears affect your efficiency _____
17. Did you strictly follow the infection control procedure every time you entered and left the inpatient area _____
18. What can be improved in your current infection control procedure _____

3. Infection Control Questionnaire 2

1. Your current living environment _____
   a. Single room
   b. Twin room
   c. Multi-person living room
   d. Own house
2. Does your residential hotel have proper infection control measures _____
   _____
3. Do your meals satisfy your daily needs _____
4. What's your foremost concern regarding the current situation _____
   a. Mental health
   b. Dining
   c. Personal protection against the virus
   d. Safety of the residential environment
   e. Leisure
5. Have you been treated with Thymosin or any other kind of preventive treatment
   _____
6. What do you think is the most common infection source for the medical staffs under current circumstances _____

(Yiqi Wu)