International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 10 No. 4, 2024
https://theaspd.com/index.php

Nosocomial Infection Prevention and Control in COVID-19 Designated Hospitals

Zhifu Wei[1]*, Somchai Bovornkitti[1], Sarisak Soontornchai[1], Jianpeng You[2]
[1]Public Health Program, Graduate School, Suan Sunandha Rajabhat University, Bangkok, 10300, Thailand
[2]Public Health, Graduate School, Guangxi University of Chinese Medicine, Guangxi, 530200, China
* Corresponding author. E-mail address: weizhifu56122@163.com

Abstract
Designated hospitals serve as critical sites for the treatment of severe COVID-19 cases, where infection prevention and control (IPC) not only safeguard healthcare workers and patients but also play a decisive role in curbing the spread of the pandemic. Drawing on recent policy documents, national standards, and practical experiences from representative hospitals in China and abroad, this study systematically examines the approaches and practices of IPC in COVID-19 designated hospitals. The analysis covers five major dimensions: an overview of the pandemic, the construction of IPC systems in designated hospitals, key technical measures, emergency management and continuous improvement mechanisms, and future challenges and directions. The findings highlight core measures such as organizational structures, process management, personnel training, engineering controls, personal protective equipment, and environmental disinfection. Furthermore, the study underscores the importance of intelligent surveillance, integration of medical care and public health, and standardized construction in strengthening IPC capacity, while also identifying persistent challenges related to viral mutations, compliance fatigue among healthcare workers, and the coexistence of multiple pathogens. These insights provide practical implications for optimizing IPC systems in designated hospitals and enhancing public health emergency preparedness.
Keywords: *COVID-19; designated hospitals; nosocomial infection prevention and control; practical study; public health*

INTRODUCTION

Novel coronavirus pneumonia (Covid-19) is caused by severe acute respiratory syndrome coronavirus 2(SARS-COV-2) and is transmitted mainly by droplets and contact. Early in the outbreak of covid-19, it was reported that 57 out of 138 coronavirus infections were nosocomial infections, of which 40 were in medical staff [1] . On 24 February 2020, the China-who joint inspection team of experts pointed out that there were 3387 cases of covid-19 infection among medical staff in 476 medical institutions in China [2] , the news of infection and even death of medical staff caused social panic, and the prevention and control of nosocomial infection became the first key to the success of epidemic prevention and control at that time. Since then, the epidemic was a worldwide pandemic, the world is concerned about the first-line treatment of medical staff infection risk. According to the data, as of February 11,2020,3019 medical workers were infected in China, accounting for 3.8% [3] , and the infection rate among medical workers in Italy and Spain was also as high as 6% or more [4] .

1 general overview of the covid-19 epidemic.

1.1 COVID-19 epidemic.

Novel coronavirus pneumonia (COVID-19) is an acute respiratory infectious disease caused by severe acute respiratory syndrome coronavirus type 2(SARS-COV-2) . The virus is highly contagious and can spread rapidly, mainly through droplets, close contact and aerosols. Since its emergence at the end of 2019, the epidemic has spread rapidly across the globe, posing an unprecedented challenge to public

health systems around the world. On 30 January 2020, WHO declared covid-19 an"International public health emergency"(PHEIC)[5] . Covid-19 was declared a global pandemic by the World Health Organization (WHO) on 11 March 2020[6] , and 205 countries have reported confirmed cases globally; The top 10 countries currently reporting cumulative confirmed cases are the United States, India, France, Germany, Brazil, South Korea, Italy, the United Kingdom, Russia, and Turkey, the top 10 countries for cumulative deaths were the United States, Brazil, India, Russia, Mexico, Peru, United Kingdom, Italy, France, and Germany [7] . On 5 May 2023, when the WHO announced that the covid-19 outbreak no longer constituted a"Public health emergency of international concern", nearly 7 million deaths were reported to WHO, who estimated that the actual number of deaths was at least 20 million [8] .

1.2 sars-cov-2 virus.

SARS-COV-2 virus is a coronavirus of the beta genus. Its genome is a single-stranded positive-stranded RNA, which is prone to mutation, resulting in a variety of variants. Since the outbreak of the epidemic, Alpha, Beta, Gamma, Delta, and Omicron variants have mainly appeared. Among them, Omicron variants and their subtypes have strong transmission ability and immune escape ability, become the main epidemic strains in the world. Variants such as JN. 1 lineage descendants continue to evolve, posing new challenges to vaccine protection and Infection Prevention and control [9] .

1.3 designated hospitals and nosocomial infection prevention and control.

Medical institutions play a vital role in the prevention and control of the covid-19 epidemic. As a centralized place for the treatment of covid-19-related cases, it is a key link to implement"External defense input, internal defense rebound", should give full and accurate play to the professional advantages of treatment, implementation of the main role of prevention and control [10] . China has entered a three-year period of strict epidemic prevention and control of the COVID-19 epidemic, and all parts of the country have continuously explored measures, experiences and practices in epidemic prevention and control, these include the establishment of designated hospitals for the centralized treatment of infected persons, strengthen the designated hospital's nosocomial infection Prevention and control work. Designated hospitals, as medical institutions that specialize in treating patients with covid-19, are the main battlefield for epidemic prevention and control.

The establishment of designated hospitals aims to concentrate medical resources, specialize in treating patients with covid-19, and minimize the risk of cross-infection in medical institutions. China's designated hospital system has played an important role in the prevention and control of the epidemic. For example, Baidong Hospital, as a designated hospital for Covid-19 in Baise City, has admitted 206 covid-19 patients and 274 convalescent patients, it has achieved the goal of"Zero death of patients, zero infection of medical staff and zero leakage of viruses"[11] . Through strict implementation of infection prevention and control measures, the designated hospitals effectively controlled the spread of the epidemic in medical institutions and ensured the normal provision of medical services.

2 construction of infection prevention and control system in covid-19 designated hospitals.

2.1 organizational structure and management system.

Establishing a scientific and perfect organizational structure is the basis for the prevention and control of designated nosocomial infection. Successful designated hospitals usually set up a leading group for epidemic work and establish a multi-level management structure for nosocomial infection prevention and control. This organizational structure ensures the authority and efficiency of infection prevention and control work.

Management System and work flow are the guarantee of infection prevention and control in designated hospitals. For example, a designated hospital has established a daily joint supervision mechanism and formulated a"Daily supervision accountability system for covid-19 prevention and control work" to rectify and implement problems within a time limit. The hospital has achieved remarkable results through multi-sector linkage mechanism, combined with information and intelligent construction, and improved the

awareness and ability of nosocomial infection prevention and control [12] . This multi-sectoral collaboration mechanism includes close cooperation among medical, nursing, nosocomial infection management, logistics and other departments to jointly build a solid defense line for infection prevention and control.

2.2 preparation and process management.

Designated hospitals need to develop a detailed work plan and process management standards, covering all aspects of patient reception, isolation, diagnosis, treatment, referral and so on. Process management needs to pay special attention to the three-channel management requirements and strengthen the management of key positions. Isolation wards, closed-loop management, health monitoring and other aspects to completely cut off the route of transmission of the virus [12] . The strict implementation of these procedures can effectively reduce the risk of cross-infection in hospitals.

2.3 personnel management and training.

Personnel management is the core of infection prevention and control. Designated hospitals need to strengthen personnel management, strictly control all checkpoints, and do a good job in the management and control of risk groups. Vaccination is the core means to reduce the risk of infection in medical care. The study found that within six months of completing vaccination, the risk of developing pneumonia (common type and above) in people infected with Covid-19 was reduced by 60% . The breakthrough infection rates of basic immunization and booster immunization were 22.6% and 6.0% , respectively. Booster immunization can reduce the breakthrough infection rate of Omicron by more than 3 times compared with basal immunization [13] . In addition, health monitoring and psychological support can not be ignored: daily temperature and nucleic acid detection combined with AI fatigue monitoring bracelet can detect potential infections in time; psychological counseling intervention can reduce the error rate of medical and protective operations by 30% . At the same time, we will carry out training for all staff, through on-site training, wechat platform, and sensor-controlled apps and other offline and online forms, organize training and assessment of medical treatment, nosocomial infection prevention and control, personal protection, nucleic acid sampling, medical waste disposal, etc. . A study on the COVID-19 outbreak among medical staff in a maternity hospital in Qatar shows that social and behavioral factors play an important role in the control of the outbreak. The underlying cause of the outbreak is that a symptomatic healthcare worker goes to work in violation of policy [14] . Therefore, it is essential to strengthen personnel behavior management and supervision.

2.4 patients and clinical waste management.

The patient management emphasized“Early isolation, single room admission”. The single room isolation was completed within 2 hours after the suspected/confirmed patients were admitted to the hospital, and the“One person, one consultation, one room” was implemented, reducing cross-infection. The medical waste was treated by“Double packaging, gooseneck ligation and special transport”. The risk of virus exposure in waste transport could be reduced by standardized treatment. At the same time, the disinfection of sewage should be strengthened.

Summary of key elements of infection prevention and control in designated hospitals

Element category	Specific content	Implementation requirements
Organizational structure	Leadership Responsibility System	The dual leadership system of dean and party secretary as co-leaders
	Dedicated management team	Establish a specialized infection prevention and control team
	Multi-department collaboration	Medical, nursing, nosocomial infection control, and logistics coordination
Process	Triage of pre-	Three-level triage system

Management	examination	
	Channel Management	Three-channel separation (patient, medical staff, and waste channels)
	Ward Management	Zonal management (clean zone, potentially contaminated zone, and contaminated zone)
Personnel Management	Training and Education	Online and offline combination, regular assessment
	Behavioral Supervision	Strengthened monitoring of compliance with protocols
	Health Monitoring	Daily health reports and symptom surveillance
Patient and Medical Waste Management	Patient isolation in a single room	Daily Treatment + health monitoring
	Medical Waste Disposal	Double-layer packaging, swan-neck tying, and dedicated transportation.
	Sewage Treatment	Discharge after disinfection

3 key technical measures for prevention and control of Covid-19 in designated hospitals.

3.1 engineering control measures.

Engineering control measures are an important means of blocking the spread of the virus. In 2025, China issued the hospital air purification management standards (WS/T 368-2025) , which clearly required medical institutions to choose air purification measures based on the results of risk assessment of respiratory infectious diseases, and refine the ventilation frequency (not less than 2 times a day, each time 30 minutes) , air conditioning system fresh air outlet setting standard (exhaust should be higher than the air inlet 6 meters) and other operational details [15] .

Environment and process optimization are the basic barriers for infection prevention and control. It is necessary to plan the layout of designated hospitals reasonably, clearly distinguish clean areas, potential pollution areas and pollution areas, and ensure that there are actual physical barriers and strict management measures between each area. Designated hospitals should strictly follow the principle of"Three zones and two channels", that is, the division of clean area, potential pollution area and pollution area, as well as the physical isolation between patients and medical staff.

Ventilation and air purification technology is an important support. Airborne transmission is an important way of SARS-COV-2 transmission in hospital. Natural ventilation is limited by building conditions, and mechanical ventilation system has become the mainstream choice. The optimization of ventilation system is particularly important, including ensuring sufficient fresh air volume, reasonable air distribution (from clean area → potential pollution area → pollution area direction) , effective air purification treatment, etc. . For high-risk areas such as isolation wards, mechanical ventilation should be used to ensure one-way airflow to prevent cross-infection. In the aspect of final disinfection, ultraviolet disinfection robot and hydrogen peroxide atomization disinfection technology gradually replace the traditional wiping.

3.2 use of personal protective equipment.

The standardized use of personal protective equipment (PPE) is a key measure to protect medical staff from infection. Designated hospitals need to formulate corresponding PPE use strategies according to different positions and operational risk levels. Disposable work caps, surgical masks and overalls may be used in low-risk areas; additional use of medical protective masks, face shields or goggles may be required in medium-risk areas; high-risk areas such as isolation wards, a higher level of protection is required, including medical respirator, face shield, protective clothing, gloves, shoe covers, etc. .

The use of PPE needs to pay attention to the correct wearing and removing process and avoid pollution. Space for wearing and removing protective equipment should be provided in a relatively separate area, with clear process instructions and supporting facilities such as mirrors. Special care should be taken to avoid contamination of clean areas when removing protective equipment, and hand hygiene should be

carried out after each step.

3.3 environmental cleaning and disinfection management.

The environmental surface may be contaminated by SARS-CoV-2 and become the medium of indirect contact transmission. Therefore, environmental cleaning and disinfection are important links in infection prevention and control. China's"Technical standard for washing and disinfection of medical fabrics in medical institutions"(WS/T 508-2025) puts forward quantitative indicators for key links such as fabric washing process and disinfectant use concentration to strengthen infection source control [15] . The designated hospitals need to develop a detailed environmental cleaning and disinfection system, including cleaning and disinfection frequency, disinfectant selection (such as effective chlorine concentration) , action time and Operation Method. High-frequency contact surfaces such as door handles, elevator buttons, bedside cabinets, call buttons should increase the frequency of cleaning and disinfection. Cleaning tools should be used in different areas, and be cleaned and disinfected in time after use, and be kept dry. The final disinfection should be more thorough, if necessary, hydrogen peroxide atomization disinfection or ultraviolet radiation and other enhanced disinfection methods.

4 emergency management and continuous improvement mechanism.

4.1 emergency response and disposal process.

Designated hospitals need to establish a sound emergency response mechanism to deal with nosocomial infections quickly and effectively. This includes the establishment of an overall vacated emergency mechanism. For example, Bazhong city central hospital should follow the requirements of the"City-level designated (reserve) Treatment Hospital's overall vacated and opening plan." When 1 or more local covid-19 cases are confirmed, the infected hospital area is vacated within 24 hours. When the number of patients admitted to the infectious disease hospital reached 60 cases, or by the city emergency command to study the need to open other hospital, the relevant hospital within 24 hours of the whole vacated [12] .

The emergency response process should include: rapid identification and reporting (detection of suspected or confirmed cases of infection) , initiation of emergency response (organization of expert consultation, confirmation of the outbreak) , epidemiological investigation (tracing the source and route of infection) , implementation of control measures (isolation of the source of infection, cutting off the route of transmission, protection of vulnerable groups) and follow-up evaluation and improvement. The hospital should organize regular emergency drills to improve the team's ability of emergency response and cooperative combat.

4.2 quality improvement and effect evaluation.

Continuous quality improvement is an important part of infection prevention and control. A multi-dimensional quality evaluation index system should be established in designated hospitals, the process indicators (such as hand hygiene compliance rate, the correct use rate of personal protective equipment) , outcome indicators (such as nosocomial infection rate, infection rate of medical staff) and system indicators (such as policy compliance, training coverage) were included.

Through regular monitoring and evaluation, the hospital can find the existing problems in time and take improvement measures. For example, through continuous exploration, Jinjiang Hospital has formed a multi-sectoral linkage mechanism, combined with information technology and intelligent construction, and achieved remarkable results, and improved the awareness and ability of nosocomial infection prevention and control [16] . The intelligent identification and control system for infectious diseases and multidrug-resistant bacteria infections constructed by the cancer prevention and Control Center of sun yat-sen university has realized the functions of automatic identification, dynamic marking, real-time sharing, pre-warning and visual guidance, it has significantly improved the identification, prevention and control rate and identification accuracy of infected people [17] .

5 future challenges and directions.

5.1 major challenges.

Although the designated hospitals have made remarkable achievements in infection prevention and control, they still face many challenges. Virus mutation is the primary challenge, and vaccine protection and infection control may be compromised as mutant strains such as Jn.1 lineage descendants continue to evolve. Health care worker fatigue and decreased compliance are also important challenges. Research has shown that social and behavioral factors play an important role in infection control, with factors such as the outbreak causing symptomatic healthcare workers to go to work in violation of policy provisions, and failure to challenge violations, lax management oversight [14] . In addition, resource constraints, public cooperation, and multi-pathogen co-circulation (such as influenza, respiratory syncytial virus, etc.) also pose additional challenges to infection prevention and control.

5.2 future directions.

In the future, the development direction of infection prevention and control in designated hospitals should include intelligent monitoring and early warning, precise prevention and control strategies, and integration of medical treatment and prevention. Intelligent Monitoring and early warning systems, such as the intelligent identification and prevention system for infectious diseases and multidrug-resistant bacteria infections developed by the cancer prevention and Control Center of Sun Yat-sen University, can realize automatic identification, dynamic labeling and real-time sharing of infection information, greatly improve the efficiency of prevention and control.

Liaoning province has launched a pilot project on the integration of medical treatment and prevention of infectious disease prevention and control, and explored the operation mode and tasks of the integration of medical treatment and Prevention in the region, the realization of information sharing, personnel cooperation and resource integration between medical institutions and public health institutions is another important direction of future development. The concept of prevention will run through the whole process of disease diagnosis and treatment in pilot hospitals, implement the responsibility of prevention and control, build an integrated model of prevention and control, and explore the establishment of a two-way training mechanism for public health personnel and clinicians.

In addition, vaccine research and development and vaccination strategies also need to be continuously optimized. In the future, vaccine effectiveness needs to be continuously monitored, and vaccine components and vaccination strategies need to be adjusted in a timely manner based on virus variation.

Standardization and normalization construction are also important directions for future development. The 16 health industry standards issued by China's National Health Commission cover key areas such as nosocomial infection control and medical practice, it will provide guidance for medical institutions across the country to establish a more scientific and accurate infection control system. The implementation of these standards will promote the scientific and refined development of nosocomial infection prevention and control.

In short, the prevention and control of nosocomial infection in covid-19 designated hospitals is a systematic project, which needs to build a comprehensive prevention and control system from the aspects of organizational structure, management system, technical measures and personnel training. In the future, with the change of virus mutation and epidemic situation, it is necessary to continuously adjust and optimize the prevention and control strategy, improve the accuracy and effectiveness of infection prevention and control, and ensure the safety of medical staff and patients.

REFERENCES

[1] WangD, HuB, HUC, etal. Clinical Characteristics of 138hospitalized Patients With 2019 Novel corona virus-Infected PneumoniainWuhan, China [J/OL] . JAMA, 2020,323(11) : 1061-1069. Doi: 10.100l/jama.2020.1585.

[2] Shi Yingchun • More than 90% of medical workers infected with the virus in China are from Hubei [EB/Ol] , (2020-02-

24)[2020-09-01] . Http://news.sma.com.cn/c/2020-02-24/doc-iimxxstf4058254.shtml.

[3] Epidemiology Group, Novel Corona virus Pneumonia Emergency Response Mechanism, Chinese Center for Disease Control and Prevention. Analysis of epidemiological characteristics of novel corona virus pneumonia [J] . Chinese Journal of Epidemiology, 2020. 41(2) : 145-151. Epidemiology Working Group for NCP Epidemic response. The epidemiological characteristics of an outbreak of 2019 novel Corona Virus Diseases (Covid-19) in China [J] . Chin J Epidemiol, 2020. 41(2) : 145-151.

[4]41 Italian health care workers have died from COVID-19: It ' s as I f a storm hit us. （2020-03-26）［2020-04-08］. Https://theweek.com/speedreads/905156/41-italian-health-care-workers-havedied-from-covid19-storm-hit.)

［5］Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel corona virus (2019-nCoV) (2020)from world health organization:https://www.who.int/news/item/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-corona virus-(2019-ncov)

[6] WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020.(2020)From WHO:https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19--11-march-2020.

[7]Live updates on the world's COVID-19 epidemic. (2022) from NetEase News : https://wp.m.163.com/163/page/news/virus_world/index.html?spss=epidemic.

[8] WHO Director-General's opening remarks at the media briefing–5 May 2023.(2023)From WHO : https://www.who.int/zh/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing--5-may-2023.）

[9] https://pmc.ncbi.nlm.nih.gov/articles/pmc12424867/

[10] Research on COVID-19 Pneumonia Prevention and Control in Tertiary General Hospitals_Xu Lu

[11]https://www.sohu.com/a/539066799_121106875

[12]https://www.workercn.cn/c/2022-10-13/7192339.shtml

[13]https://www.163.com/dy/article/H0LAGN7005345ARW.html

[14]https://pubmed.ncbi.nlm.nih.gov/40959636/

[15]https://www.yxj.org.cn/detailPage?articleId=482469

[16]http://fj.people.com.cn/BIG5/n2/2025/0604/c181466-41249382.html

[17]https://www.medsci.cn/article/show_article.do?id=e1588e41240f