

Respiratory Protection Recommendations and Guidance against COVID-19 in China

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The Chinese government has taken strong prevention and control measures to fight against the spread of coronavirus disease 2019 (COVID-19), such as promoting public awareness of disease prevention, stopping large gatherings, wearing masks, etc., to reduce the risk of human infection

The source of COVID-19 infection is mainly novel coronavirus infected patients. Asymptomatic infected persons can also become the sources of infection. Respiratory droplets and close contact transmissions have been regarded as the main routes of transmission. There is also a possibility of aerosol transmission in a relatively closed environment for a longer exposure time. Other routes of transmission need to be clarified. The whole population is susceptible (National Health Commission of the PRC, 2020.3.7).

Among all control measures, respiratory protection plays a key role in prevention and control of COVID-19. Based on the characteristics of different population groups, the Chinese Center for Disease Control and Prevention (CCDC) has issued recommendations and guidance on respiratory protection against COVID-19.

Recommendations for Key Groups (COVID-19 Carriers)

Key groups include suspected, confirmed, and asymptomatic infected persons. A suspected person is the one who had a close contact with a confirmed case or an asymptomatic infected person. For those people, surgical masks or KN95/N95 or higher efficiency level respirators (without a breathing valve) are recommended to wear (National Health Commission of the PRC, 2020.3.18).

Recommendations for Special Populations (Healthcare Personnel)

In order to cooperate with the implementation of the Prevention and Control Plan of COVID-19 (Version 6) issued by the National Health Commission of People's Republic of China, the Chinese Center for Disease Control and Prevention (CCDC) revised the relevant technical documents according to the current situation of COVID-19 in China and formed the latest personal protection guidelines including respiratory protection for special groups (CCDC, 2020.3.8). This guideline is applicable to all professionals in fighting against COVID-19. They are epidemiological investigators, staff working in isolation wards and medical observation sites, workers transporting asymptomatic patients and infected persons, worker handling corpse disposals, environmental cleaning and disinfection personnel, specimen collection and laboratory technicians, etc. For respirator selection, the guideline makes special

requirements and recommendations. The following are the detailed respiratory protection plans for different professionals.

Epidemiological investigators: When interviewing people who had close contacts with an infected person, surgical masks should be worn. When interviewing suspected, confirmed, or asymptomatic cases, it is recommended to wear a KN95/N95 or higher filter efficiency level filtering facepiece respirator (FFR), or a surgical N95 respirator, paired with safety goggles and a face shield.

Staff working in isolation wards and medical observation sites: They were mainly doctors, nurses, other medical personnel and cleaning staff. Surgical N95 respirators or power air purifying respirators (PAPR) paired with safety goggles and a face shield are recommended.

Workers transporting asymptomatic patients and infected persons: They may be the ambulance drivers, emergency doctors, nurses, etc. Surgical N95 respirators or power air purifying respirators (PAPR) paired with safety goggles and a face shield are recommended.

Worker handling corpse disposals: KN95/N95 (or higher rated) FFRs, surgical N95 respirators, or power air purifying respirators (PAPRs) and a face shield are recommended.

Environmental cleaning and disinfection personnel: KN95/N95 (or higher rated) FFRs, surgical N95 respirators, or power air purifying respirators (PAPRs) and a face shield are recommended. When a PAPR is used, gas, vapor and particulate combined cartridges or canisters according to the types of disinfectants should be selected.

Specimen collectors: KN95/N95 (or higher rated) FFRs, surgical N95 respirators, or power air purifying respirators (PAPRs) and a face shield are recommended.

Laboratory technicians: KN95/N95 (or higher rated) FFRs, surgical N95 respirators, or power air purifying respirators (PAPRs) paired with safety goggles and a face shield are recommended.

In summary, the recommended selection principles of respiratory protective equipment for special populations are shown in Table I (CCDC, 2020.2.12). Single-use medical face masks, which conform to Chinese YY/T 0969-2013 (National Medical Products Administration, 2013), are used in general medical environment to block the biological pollutants exhaled from oral or nasal cavities. The bacterial filtration efficiency (BFE) of single-use medical face masks should not be less than 95%; however, particulate filtration efficiency is not required. Medical personnel are not recommended to wear single-use medical face masks against COVID-19. Surgical masks, which conform to Chinese YY 0469-2011 (National Medical Products Administration, 2011), are suitable for clinical staff members during invasive operations. This type of mask provides a physical barrier to prevent the direct passage of pathogenic microorganisms, body fluids and particulate matters, and the filtration efficiencies for bacteria and non-oily particulates are not less than 95% and 30%, respectively. There are no fit test requirements for both single-use medical face masks and surgical masks. Protective face masks for medical use (equivalent to surgical N95 FFRs used in the U.S.), which conform to GB19083-2010 (General Administration of Quality Supervision, Inspection and Quarantine of PRC and Standardization Administration, 2010), and are worn in medical environment to filter biological aerosols such as virus and bacteria and block droplets, blood, body fluids, secretions, etc. The filtration efficiency for non-oily particles is not less than 95%. It is required to be fit tested before using surgical N95 FFRs, and the fit factor should not be less than 100. The filtration efficiencies of non-oily particles are not less than 95%. There is no test requirement of surface fluid resistance for KN95 respirators (which conform to GB2626-2019 (State Administration of Market Regulation and Standardization Administration, 2019) and N95 respirators (certified by the U.S. NIOSH). KN95 respirator has the requirement of total inward leakage. KN95/N95 respirators are recommended for medical personnel protection when working against COVID-19. Surgical N95 respirators can be used in invasive operations, but KN95/N95 respirators are not allowed. However, it should be emphasized that, in

special populations, the following groups require higher levels of respiratory protection. They are operators engaged in the collection of respiratory specimens and staff members who performed tracheotomy, endotracheal intubation, endotracheal endoscopic examination, sputum aspiration, cardiopulmonary resuscitation, or lung transplantation and pathologic anatomy of COVID-19 patients. Hood type (or full-face mask) PAPRs or half-face mask type PAPRs with goggles or full screen are suggested. Both types of PAPRs should use P100 particulate filter elements. PAPR equipment can be reused after disinfection. But reuse of the filter elements is not allowed (National Health Commission of PRC, 2020.3.18).

Table I. Selection of Respirators for Special Populations

Healthcare Personnel		Surgical Mask	KN95/N95 or above Particle Respirator	Protective Face Mask for Medical Use (Surgical N95 Respirator)	Powered Air-Purifying Respirator
Epidemiological investigators	investigating the close contacts	√			
	investigating suspected or confirmed cases and asymptomatic infected persons		√	√	
Staff who worked in isolation wards and medical observation sites				√	√
Participants in the transportation of cases and asymptomatic infected persons				√	√
Cadaver handlers			√	√	√
Environmental cleaning and disinfection personnel			√	√	√
Specimen collectors			√	√	√
Laboratory staff			√	√	√

Recommendations for General Population

For general population, other than key groups and special population, appropriate respiratory protection should be selected according to the “Public Protection Guideline of COVID-19” by CCDC (CCDC, 2020.3.6). Respiratory protection of this group needs to be completed jointly with individual consciousness and community management following the guidance of technical documents.

Surgical masks are suggested for the following personnel: Medical staff working in the general outpatients and wards; Staff in crowded places, including hospitals, airports, railway stations, subways, ground buses, planes, trains, supermarkets, restaurants and other relatively closed places; Others engaged in COVID-19 related administrative management, policeman, security, courier and so on; People in home quarantine and those live with them.

Single-use medical face masks are suggested for: The public in crowded areas such as supermarkets, shopping malls, vehicles and elevators; Indoor office environment; Patients in medical institutions, except fever clinic.

No masks required or non-medical face masks are suggested for: Indoor activities at home, scattered residents; Outdoor activities, including students/children in open spaces; Workers in well-ventilated workplaces or in low-density places.

Non-medical face masks, such as cotton, sponge, activated carbon masks also have effects of reducing droplets spread by cough, sneezing, speaking, etc. Due to the limits of resource, the use (usage time and frequency) of masks or respirators may be prolonged during the COVID-19 epidemic on the premise of protecting public health (CCDC, 2020.3.6). However, attentions should be paid based on the characteristics of the population and the types of masks and respirators used. People with high-risk exposure need to change for a new mask or respirator when re-entering an infected area after taking off the old protective equipment due to changing of work shift, eating, going to the toilet, etc. (CCDC, 2020.3.6).

All medical-standard masks or respirators have usage restrictions. Single-use medical face masks and surgical masks are one-time use only, and the cumulative time of use is not more than 8 hours. Respirators should not be used continuously for more than 4 hours, and reuse is not permitted when worn against COVID-19 (National Health Commission of PRC, 2020.3.18). If there is a shortage of protective face masks for medical use (e.g., surgical N95 respirators), particulate respirators that meet KN95/N95 and above standards can be used instead. Elastomeric half-mask or full facepiece respirators equipped with N95 or above particulate filters/cartridges can also be chosen, whereas PAPR with P100 filters is an even better choice (National Health Commission of PRC, 2020.2.5). At this point, there is no evidence to prove the effectiveness of various methods regarding cleaning and disinfecting masks and respirators (National Health Commission of PRC, 2020.3.18), and therefore reuse is not recommended.

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