

# Title Page

## 1. Title

Consensus of Chinese experts on protection of skin and mucous membrane barrier for healthcare workers fighting against coronavirus disease 2019

## 2. Information of authors

Yicen Yan\*, Hui Chen, Liuqing Chen, Bo Cheng, Ping Diao, Liyun Dong, Xinghua Gao, Heng Gu, Li He, Chao Ji, Hongzhong Jin, Wei Lai, Tiechi Lei, Li Li, Liuyi Li, Ruoyu Li, Dongxian Liu, Wei Liu, Qianjin Lu, Ying Shi, Jiquan Song, Juan Tao, Baoxi Wang, Gang Wang, Yan Wu, Leihong Xiang, Jun Xie, Jinhua Xu, Zhirong Yao, Furen Zhang, Shaomin Zhong, Jianzhong Zhang, Hengjin Li, Hang Li\*\*

\*As one of the original authors, she is responsible for the translation and revision of the English version.

\*\* All authors contribute equally to this article.

Yicen Yan

Affiliation: Department of Dermatology, Peking University First Hospital

National Clinical Research Center for Skin and Immune Diseases

Beijing Key Laboratory of Molecular Diagnosis on Dermatoses

Address: No.8 Xishiku St., Xicheng District, Beijing, China

Hui Chen

Affiliation: Department of Dermatology, Tongji Hospital of Tongji Medical College, Huazhong

University of Science and Technology

Address: No.1095 Jie Fang Avenue, Hankou, Wuhan 430030, P.R. China.

Liuqing Chen

Affiliation: Department of Dermatology, Wuhan No.1 Hospital

Address: No. 215 Zhongshan Avenue, Qiaokou District, Wuhan, Hubei, P.R. China.

Bo Cheng

Affiliation: Department of Dermatology, First Affiliated Hospital of Fujian Medical University

Address: No. 20, Chazhong Rd., Taijiang District, Fuzhou, Fujian, P. R. China

Ping Diao

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1111/dth.13310

Affiliation: Department of Dermatology, West China Hospital of Sichuan University

Address: No.37 Guoxue Alley, Wuhou District, Chengdu City, Sichuan Province, P.R. China

Liyun Dong

Affiliation: Department of Dermatology, Union Hospital, Tongji Medical College, Huazhong

University of Science and Technology

Address: 1277 Jiefang Avenue, Wuhan, Hubei Province, P. R. China

Xinghua Gao

Affiliation: Department of Dermatology, Chinese Medical University First Hospital

Address: No. 155 Nanjing North St., Heping District, Shenyang, Liaoning Province, P. R. China

Heng Gu

Affiliation: Hospital for Skin Diseases, Chinese Academy of Medical Sciences

Address: 12 Jiangwangmiao St., Nanjing, Jiangsu Province, P. R. China

Li He

Affiliation: Department of Dermatology, First Affiliated Hospital of Kunming Medical University

Address: 295 Xichang Rd., Wuhua District, Kunming, Yunnan Province, P. R. China

Chao Ji

Affiliation: Department of Dermatology, First Affiliated Hospital of Fujian Medical University

Address: No. 20, Chazhong Rd., Taijiang District, Fuzhou, Fujian, P. R. China

Hongzhong Jin

Affiliation: Department of Dermatology, Peking Union Medical College Hospital

Address: No.1 Shuaifuyuan Wangfujing Dongcheng District, Beijing, China 100730

Wei Lai

Affiliation: Department of Dermatology, The Third Affiliated Hospital, Sun Yat-Sen University

Address: No. 600 Tianhe Road, Tianhe District, Guangzhou, Guangdong, China

Tiechi Lei

Affiliation: Department of Dermatology, Renmin Hospital of Wuhan University

Address: Wuhan, Hubei Zhang Road (formerly Ziyang Road) Wuchang District No. 99 Jiefang Road 238

Li Li

Affiliation: Department of Dermatology, West China Hospital of Sichuan University

Address: No.37 Guoxue Alley, Wuhou District, Chengdu City, Sichuan Province, PR China

Liuyi Li

Affiliation: Department of Infection Control, Peking University First Hospital

Address: No.8 Xishiku St., Xicheng District, Beijing, China

Ruoyu Li

Affiliation: Department of Dermatology, Peking University First Hospital

National Clinical Research Center for Skin and Immune Diseases

Beijing Key Laboratory of Molecular Diagnosis on Dermatoses

Address: No.8 Xishiku St., Xicheng District, Beijing, China

Dongxian Liu

Affiliation: Department of Dermatology, Tongji Hospital of Tongji Medical College, Huazhong

University of Science and Technology

Address: No.1095 Jie Fang Avenue, Hankou, Wuhan 430030, P.R. China.

Wei Liu

Affiliation: Department of Dermatology, Air Force General Hospital of PLA

Address: No. 30 Fucheng Rd., Haidian District, Beijing, P.R. China.

Qianjin Lu

Affiliation: Department of Dermatology, The Second Xiangya Hospital of Central South

University

Address: No.139 Renmin Road Central Changsha-Hunan-China

Ying Shi

Affiliation: Department of Dermatology, Renmin Hospital of Wuhan University

Address: Wuhan, Hubei Zhang Road Wuchang District No. 99 Jiefang Road 238

Jiquan Song

Affiliation: Department of Dermatology, Zhongnan Hospital of Wuhan University

Address: No.169, East Lake Road, Wuchang District, Wuhan, Hubei Province, China

Juan Tao

Affiliation: Department of Dermatology, Union Hospital, Tongji Medical College, Huazhong

University of Science and Technology

Address: 1277 Jiefang Avenue, Wuhan, Hubei Province, P. R. China

Baoxi Wang

Affiliation: Plastic Surgery Hospital, Chinese Academy of Medical Sciences, Peking Union Medical College

Address: No. 33, Badachu Road, Shijingshan District, Beijing, China

Gang Wang

Affiliation: Department of Dermatology, Xijing Hospital, Air Force Medical University of PLA

Address: No.169, Changle West Road, Xi'an, Shaanxi, 710032, P.R.China

Yan Wu

Affiliation: Department of Dermatology, Peking University First Hospital

National Clinical Research Center for Skin and Immune Diseases

Beijing Key Laboratory of Molecular Diagnosis on Dermatoses

Address: No. 8 Xishiku St., Xicheng District, Beijing, China

Leihong Xiang

Affiliation: Department of Dermatology, Huashan Hospital, Fudan University

Address: No. 12 Urumqi Middle Rd., Shanghai, P.R.China

Jun Xie

Affiliation: Department of Dermatology, Zhongnan Hospital of Wuhan University

Address: No. 169, East Lake Road, Wuchang District, Wuhan, Hubei Province, China

Jinhua Xu

Affiliation: Department of Dermatology, Huashan Hospital, Fudan University

Address: No. 12 Urumqi Middle Rd., Shanghai, P.R.China

Zhirong Yao

Affiliation: Department of Dermatology, Xinhua Hospital Affiliated to Shanghai Jiaotong University School of Medicine

Address: No. 1665 Kongjiang Rd., Yangpu District, Shanghai, P.R.China

Furen Zhang

Affiliation: Shandong Academy of Medical Sciences

Address: No. 18877 Jingshi Rd., Ji'nan, Shandong Province, P.R.China

Jianzhong Zhang

Affiliation: Department of Dermatology, Peking University People's Hospital

Address: No.11 Xizhimen South Street, Xicheng District, Beijing, P.R.china

Shaomin Zhong

Affiliation: Department of Dermatology, Peking University First Hospital

National Clinical Research Center for Skin and Immune Diseases

Beijing Key Laboratory of Molecular Diagnosis on Dermatoses

Address: No.8 Xishiku St., Xicheng District, Beijing, China

Hengjin Li

Affiliation: Department of Dermatology, Hainan Hospital of PLA General Hospital

Address: Haitang Bay, Sanya, Hainan Province, China

Hang Li

Affiliation: Department of Dermatology, Peking University First Hospital

National Clinical Research Center for Skin and Immune Diseases

Beijing Key Laboratory of Molecular Diagnosis on Dermatoses

Address: No.8 Xishiku St., Xicheng District, Beijing, China

### 3. Information of corresponding authors

Hang Li

Address: Department of Dermatology, Peking University First Hospital, No.8 Xishiku St.,  
Xicheng District, Beijing, China

Email: drlihang@126.com

Hengjin Li

Address: Department of Dermatology, Hainan Hospital of PLA General Hospital, Haitang Bay,  
Sanya, Hainan Province, China

Email: lhengjin@163.com

### 4. Acknowledgments

In the process of questionnaire survey and consensus writing, we have received great support from many dermatologists in Hubei Province and medical staff in the frontline of fighting COVID-19.

This article has been previously published on the Chinese Journal of Dermatology (doi:10.35541/cjd.20200112). Editorial consent for republishing was obtained from Dermatologic Therapy and Chinese Journal of Dermatology.

No funding or sponsorship was received for this study or publication of this article.

All named authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published.

All authors have no conflict of interest.

# Consensus of Chinese experts on protection of skin and mucous membrane barrier for healthcare workers fighting against coronavirus disease 2019

China Dermatologist Association

Chinese Society of Dermatology

National Clinical Research Center for Skin and Immune Diseases

## Abstract

Health professions preventing and controlling Coronavirus Disease 2019 are prone to skin and mucous membrane injury, which may cause acute and chronic dermatitis, secondary infection and aggravation of underlying skin diseases. This is a consensus of Chinese experts on protective measures and advice on hand-cleaning- and medical-glove-related hand protection, mask- and goggles-related face protection, UV-related protection, eye protection, nasal and oral mucosa protection, outer ear and hair protection. It is necessary to strictly follow standards of wearing protective equipment and specification of sterilizing and cleaning. Insufficient and excessive protection will have adverse effects on the skin and mucous membrane barrier. At the same time, using moisturizing products is highly recommended to achieve better protection.

**Keywords:** COVID-19; Healthcare workers; Protect; SARS-CoV-2; Skin and mucous membrane barrier.

Since December 2019, coronavirus disease 2019 (COVID-19) has rapidly spread across China. Over 10,000 healthcare workers (HCWs) are summoned to Hubei Province to combat against epidemic. Based on the experience from severe acute respiratory syndrome (SARS) outbreak in 2003, HCWs were vulnerable to skin and mucosa barrier breakdown due to frequent cleansing and long-term use of personal protective equipment (PPE). These preventive measures can cause acute and chronic dermatitis, secondary infections and aggravation of existing skin diseases.

To assess the potential skin damage, a recent cross-sectional study surveyed 330 HCWs working at fever clinics and inpatients ward of COVID-19 cases. The results showed that 71% of respondents

reported self-perceived skin barrier damage. The main symptoms were burning, itch and stinging. The most commonly reported types of eruptions were dryness or scales, papules or erythema, and maceration. Since frontline HCWs frequently encounter skin and mucous barrier damage, the consensus for protecting skin and mucosa barrier were jointly written by China Dermatologist Association, Chinese Society of Dermatology and National Clinical Research Center for Skin and Immune Diseases.

#### Hand protection measures

##### (1). Hand hygiene-related skin barrier protection

The survey showed that 66.1% of HCWs washed hands over 10 times per day, but only 22.1% took protective skincare measures after washing. A large epidemiological study in Sweden reported that prolonged water exposure induces skin irritation (Meding et al., 2017). Therefore, standardizing moments and disinfectants for hand hygiene and emphasizing skincare after hand washing are essential for hand care.

##### (a). Moments for hand hygiene

According to Specification of Hand Hygiene for Healthcare Workers (WS/ T313-2019) (National Health Commission of the People's Republic of China, 2019), hand hygiene should adhere to "two before and three after". It includes before touching a patient, before any aseptic procedure (including invasive procedure) is performed, after potential exposure to patient's body fluid, after touching a patient, and after touching a patient's surroundings or items that might be contaminated. If PPE is regularly used by HCWs, the above-mentioned moments for hand hygiene can be replaced by glove decontamination. However, some extra moments (Li & Wu, 2020) need to be addressed: 1) before donning PPE, 2) before, during and after doffing PPE, 3) before leaving affected area, 4) before eating or drinking, 5) before and after defecation, and 6) after reaching the residence. In addition, sufficient quantities of alcohol-based hand rub are essential for cleaning. Washing hands need both hand detergents and running water. Wearing gloves is not a substitute for hand hygiene.

##### (b). Suggestions on hand detergents.

2019-nCoV shows low resistance to disinfectants. Ultraviolet (UV) disinfection, hot water bath with water of 56°C (132.8°F) for 30 minutes, chlorine-containing disinfectants, peracetic acid or 75% ethanol can effectively inactivate the virus. Therefore, qualified compound hand disinfectants using ethanol as the main component are prioritized for hand decontamination.



In daily life outside of work, foamless cleansing products containing moisturizing ingredients are recommended to reduce the sustained damage of skin barrier caused by soaps and other alkaline detergents (General Office of the National Health Commission of the People's Republic of China & National Administration of Traditional Chinese Medicine, 2020; WHO, 2020).

(c). Skincare measures after hand hygiene: Apply hand cream every time after hand hygiene if the condition allows. If wearing gloves for a long duration, emollients containing hyaluronic acid, ceramide, vitamin E or other repairing ingredients (Kownatzki, 2003) are encouraged. Urea-containing emulsions are recommended in treating skin rhagadia.

## (2). Gloves-related protective measures

The survey showed that 12.4% of HCWs wear three layers of gloves at the same time during daily work. Long-term use of gloves may lead to overhydration of stratum corneum, which may cause maceration and erosion. Chemical materials in latex gloves are likely to cause contact dermatitis in macerated or erosive skin. To make it worse, damaged skin is vulnerable to secondary infection. Hence, several points should be emphasized when wearing gloves.

(a). Correct layers of gloves: one layer of qualified latex gloves is adequate for skin protection. Additional layer is recommended for HCWs with existing skin barrier damage or underlying risk of gloves broke. Theoretically, the increased layers of gloves cannot add to protective effect proportionally, however, gloves-related adverse skin reactions may increase.

## (b). Skincare measures after long-term use of gloves

Latex gloves are most commonly used in the work. Long-term use of latex gloves easily causes maceration, characterized by whitening, softening, and wrinkling of the skin. Avoid wearing gloves for a long time and apply hand cream can reverse maceration. If maceration cannot be relieved and subsequent erosion and exudation occur, hydropathic compress with 3% boric acid solution or normal saline or topical use of zinc oxide ointment is recommended. Patients with contact dermatitis can use topical glucocorticoid cream. Use of cotton gloves inside latex gloves are encouraged. Frequent cleansing and prolonged use of gloves may aggravate existing hand eczema. Moisturizers together with topical glucocorticoid cream are recommended. However, prompt referral to dermatologists is necessary if sustained rashes or inflammatory symptoms appear.

## 2. Masks and goggles-related facial protection

The adverse skin reactions caused by prolonged wearing of masks and goggles include pressure injury, urticaria, contact dermatitis, skin dryness and aggravation of existing skin diseases. According to a report from Singapore during the SARS outbreak in 2003, 35.5% HCWs reported acne (59.6%), facial itch (51.4%), and rash (35.8%) from N95 mask use (Bhojwala et al., 2019; Foo, Goon, Leow, & Goh, 2006).

(1). Protective measures for pressure injury (Berlowitz, 2020)

(a). The choice of masks: Wear a properly fitted mask. Use masks in different ways alternately to avoid sustained friction and pressure on the same site.

(b). Application of moisturizers or gel: Apply moisturizers or gel before wearing facial protective equipment to lubricate and reduce friction between skin and masks or goggles.

(c). Correct use of goggles: The main purpose of using goggles is to avoid being infected by transmissible splash. Over-tight using cannot enhance the protective effect but damage the skin and generate fogs instead.

(d). Management of skin indentation: Most mild skin indentation can regress spontaneously. Therapeutic measures for redness and swelling include hydropathic compress with 3-4 layers of gauze soaked by cold water or normal saline for about 20 minutes each time every 2-3 hours and then applying moisturizers. Avoid washing with over-heated water, ethanol or other irritative products.

(e). Management of severe skin indentation: To avoid infection secondary to severely swollen or blistered and erosive lesions, hydropathic compress with povidone iodine diluted by normal saline at a ratio of 1:9 can be used on face. 3% boric acid solution is better on hands. It is encourage to apply medical dressing after hydropathic compress. Application of moisturizers on intact skin and topical antibiotic ointments such as compound polymyxin B, mupirocin or fusidic acid on infected skin are recommended.

(2). Treatment of urticaria (Jeff Donovan, Kudla, Holness, Skotnicki-Grant, & Nethercott, 2007; Hui, Tang, & Li, 2010; Liu & Liu, 2014)

Delayed pressure urticaria may be caused by vertical pressure from PPE. Preventive measures include: 1) choose well-fitted PPE and avoid using over-tightly, 2) change to other types of PPE, 3) antihistamines such as Cetirizine and Loratadine are preferred for urticaria, antileukotriene agents may be added if needed.

(3). Treatment of contact dermatitis caused by masks (Al Badri, 2017; J. Donovan & Skotnicki-Grant, 2007; Warshaw et al., 2019)

Preventive measures and treatment for contact dermatitis include: 1) Apply emollients before wearing masks; 2) Once itch or stinging appears, masks of other materials should be employed. If specific materials cannot be avoided, put two layers of gauze inside the mask. 3) Avoid facial cleansing with over-hot water, 75% ethanol or facial cleanser. For mild contact dermatitis, applying moisturizers after cleansing is sufficient. For severe ones, low- to medium-potency topical glucocorticoids without fluorine are recommended. Management for blisters and erosion is hydropathic compress and subsequent topical glucocorticoid ointment (the same treatments for mild skin indentation). Patients reporting severe pruritus can take antihistamines orally.

#### (4). Management of skin dryness and scales

Closed and humid environments caused by water in exhaled air may cause skin barrier dysfunction and lead to subsequent skin dryness and scales. Applying high-potent moisturizers before and after wearing PPE is paramount to prevent such discomfort.

(5). Management of other dermatoses aggravated by masks or goggles (Bhoirul et al., 2019; Foo et al., 2006; Tan & Greaves, 2004)

(a). Acne vulgaris: Prolonged wearing of masks and goggles may aggravate existing acne vulgaris. Plausible mechanisms include rupture of comedones induced by pressure and friction, occlusion of pilosebaceous duct, microcirculation dysfunction due to long-term pressure, and humid environment which is conducive to bacteria proliferation. The management of acne vulgaris includes: 1) Apply moisturizers containing oil control ingredients before and after using of masks. 2) Use topical antibiotic creams or benzoyl peroxide for mild papules and pustules, and topical retinoids creams for blackhead and whitehead. 3) Severe acne vulgaris should be treated under the guidance of dermatologists in time.

(b). Other facial skin disorders: Seasonal facial dermatitis, seborrheic dermatitis and rosacea can be aggravated by wearing masks and goggles. Preventive measures include: 1) Control time of wearing preventive equipment; 2) Use gauze inside masks; 3) Apply moisturizers before donning and after doffing masks; 4) Adhere to previous treatments under the guidance of dermatologists; 5) Consult dermatologists if sustained aggravation exists.

#### 3. UV-related protection

16.7% of HCWs have experienced direct exposure to ultraviolet light according to the survey. Following suggestions are proposed accordingly.

(1). Avoid direct exposure to UV irradiation

Short-term close exposure to UV irradiation without eye protection can damage the cornea and conjunctival epithelium, resulting in keratitis presenting with eyelid redness, conjunctival congestion and chemosis, foreign body sensation, pain, photophobia and blurred vision. Cutaneous reaction to UV irradiation includes erythema, swelling, exudation, pain and tenderness. In addition, over-inhalation of ozone produced by some UV disinfection lamps (UDLs) may cause dizziness, nausea and other adverse reactions(Tenkate, 1999). Therefore, HCWs should avoid direct exposure to UV irradiation, especially close and long-term exposure.

(2). Protection for UV irradiation

For unexpected exposure to UV irradiation, preventive measures include: 1) Avoid looking at UDLs directly; 2) Cover exposed areas with clothes; 3) Leave or turn off UDLs as soon as possible; 4) Consult an ophthalmologist if eyelid redness, conjunctival congestion and swelling, foreign body sensation, pain, photophobia and blurred vision occur.

(3). Treatment for UV-related disorders

(a). Systemic treatment: Oral intake of non-steroidal anti-inflammatory drugs including ibuprofen and acetaminophen or opioids, if necessary, is useful to relief ocular or cutaneous pain. Ophthalmic examination is important to eliminate fundus abnormalities(Jacobs, 2018). In case of generalized lesions or systemic symptoms, oral glucocorticoid is recommended when necessary.

(b). Treatment of eyes: Consult ophthalmologists for further treatment.

(c). Treatment of skin disorders: 1) Mild erythema: calamine lotion or topical low- to medium-potency glucocorticoid; 2) Edematous erythema: calamine lotion and topical medium- to high-potency glucocorticoid. 3) Exudation: hydropathic compress with normal saline or boric acid solution. 4) Blisters: mild blisters can absorb spontaneously. For severe ones, use sterile syringe to aspirate the liquid of blister and wash damaged skin with normal saline and then cover sterile dressings. Antibiotic ointment is suggested if necessary(Gu, 2009).

4. Hydrosis-related protection

According to the survey, 56.7% of HCWs wore PPE for over 6 hours per day. Getting all wet after shift was reported in 64.5% of HCWs. Overhydration tends to cause cutaneous dysbacteriosis and skin

barrier damage. Besides, the performance of PPE will also decline simultaneously with hydrosis(Li & Wu, 2020).

Preventive measures include: 1) Control working hours with PPE. 2) Shower timely once leaving the contaminated areas. 3) Frequent shower may lead to progressive removal of surface lipids and a consequent loss of stratum corneum which would cause itch, scales, rhagades and other rashes. Avoiding shower with over hot water, using weak acidic or neutral detergents instead of alkaline ones and applying moisturizers generally after shower are encouraged.

#### 5. Eye protection

Previous study indicated that 2019-nCoV may transmit through the conjunctiva(Lu, Liu, & Jia, 2020).

Preventive measures include: 1) Adhere to standardized wearing of goggles. It should cover the hat completely in order to avoid exposure of eyes and periocular skin; 2) Strictly follow guidance of donning and doffing PPE and avoid touching the eyes and periorbital regions with contaminated hands or gloves. 3) In case of suspicious history of exposure when doffing goggles, wipe periocular skin with wrung 75% ethanol cotton ball. Too much ethanol may cause irritation of conjunctiva and cornea. Consult an ophthalmologist timely when necessary.

#### 6. Nasal mucosa protection

Nasal vestibule mucosa is a vulnerable area for virus or bacteria to colonize for its abundant blood vessels, mucinous glands and serous glands which create a humid environment. angiotensin converting enzyme-2(ACE2) expression was found in the basal layer of the non-keratinizing squamous epithelium in nasal mucosa, indicating that coronavirus may infect nasal mucosa cells if basal layer is exposed due to nasal mucosa barrier breakdown(Hamming et al., 2004). Accordingly, HCWs should clean nasal cavity once leaving isolated wards and pay attention to the protection of upper respiratory tract and mucosa(General Office of the National Health Commission of the People's Republic of China, 2020b).

##### (1). Adhere to the standards

Adhere to the standards on wearing PPE(General Office of the National Health Commission of the People's Republic of China, 2020b).

##### (2). Nasal vestibule cleansing

Strictly follow the Standard of Nasal Vestibule Hygiene for Healthcare Workers (DB12/T551-2014)(Tianjin Administration for Market Regulation, 2014).

(a). Moments for cleansing: Before leaving clean zone or getting off work.

(b). Moments of sterilizing: masks or nasal cavity is contaminated with patient's blood, body fluid or secretion.

(c). Nasal vestibule cleansing: 1) Wash hand following Specification of Hand Hygiene for Healthcare Workers(National Health Commission of the People's Republic of China, 2019); 2) Clean nasal vestibule with normal saline, tap water or suds, or wipe the nasal vestibule using cotton swab dipped with water for 3-5 rounds to ensure entire cleansing (watch out when using cotton swab as it may damage mucosa), or cleanse with nasal aspirator. 3) Trim nose hair properly. 4) Wash face with running water and get it dried afterwards.

(d). Nasal vestibule sterilization: 1) Mucosa disinfectant should meet the requirements of General Standards for Disinfectant of Mucous Membrane(Ministry of Health of People Republic of China, 2011); 2) Wash hands following Specification of Hand Hygiene for Healthcare Workers(National Health Commission of the People's Republic of China, 2019); 3) Use cotton swab dipped with mucosa disinfectants to enter the bilateral nasal vestibule and wipe for 3-5 rounds. 4) Cleanse nasal vestibule following the above-mentioned nasal vestibule cleansing instruction.

## 7. Oral mucosa protection

### (1). Preventive measures

(a). Follow the standards: Adhere to the standards on wearing protective masks(Centers for Disease Control and Prevention, 2020a; General Office of the National Health Commission of the People's Republic of China, 2020a). Avoid mouth-breathing in contaminated or semi-contaminated areas. Keep lips from contacting the contaminated side of the masks when doffing.

(b). Keep oral cavity from contaminants: Touching lips is prohibited until strict hands disinfection(Centers for Disease Control and Prevention, 2020b). Direct contact with oral mucosa should be prohibited even after disinfection. Close lips tightly when cleansing face and hair after leaving contaminated area to avoid contaminated water entering into oral cavity.

(c). Hygiene during eating and drinking: Make tableware and container mouth clean before eating and drinking. Avoid touching the container mouth when screwing the bottle cap. Drink disposable bottled water if possible. Do not lick lips and wipe with a clean tissue if necessary.

## (2). Protective measures for oral care

Oral bacteria tend to colonize on teeth and gingiva due to long-term wearing of masks and insufficient water intake, which may consequently cause oral diseases including halitosis, gingival bleeding, aggravation of periodontitis and oral ulcers(Xu & Ma, 2012; Z. Zhang, 2008). Protective oral care includes brushing teeth every morning and night, using mouthwash or brushing teeth after meals and ensuring timely water intake. Rinse mouth with water or normal saline when getting off work(Chen, 2003; J. Zhang et al., 2008) and drink boiled water after rinsing. Pay attention to lip moisturizing by applying lip balm before donning and after doffing PPE. Dryness of oral mucosa is conducive to the proliferation of bacteria(Coleman, 2002), hence it is important to maintain oral and pharyngolaryngeal humidity.

## 8. Protective measures for external ear

The risk of external ear contamination is relatively low. However, ear-dependent masks may damage external ears and retroauricular areas and increase the risk of infection. Protective measures include: 1) Cover retroauricular areas with a surgical cap before wearing ear-dependent protective equipment. 2) Clean and dry the external ear and its canal with cotton swab in time after taking off PPE. Moisturizers are recommended after cleansing. 3) Choose non-ear-dependent masks to reduce pressure on retroauricular areas if possible. Moisturizers and thin hypoallergic dressing can do help to reduce friction between skin and masks. 4) Carefully check retroauricular areas for skin indentation. Treat the lesions with previously mentioned management of skin indentation(General Office of the National Health Commission of the People's Republic of China & National Administration of Traditional Chinese Medicine, 2020; Zhao, 2017).

## 9. Protective measures for hair

Scalp pruritus, folliculitis and exacerbation of existing scalp seborrheic dermatitis resulted from hydrosis, and hair contamination are frequently reported in frontline HCWs. No standards for hair protection so far. Here are suggestions for hair protection(General Office of the National Health Commission of the People's Republic of China, 2020b; General Office of the National Health Commission of the People's Republic of China & National Administration of Traditional Chinese Medicine, 2020; X. Zhang, Zhang, & Lu, 2019).

## (1). Protective measures for hair/scalp

1) Short hair is recommended regardless of gender so as to completely covered by surgical cap during the work. 2) Strictly follow the standards on wearing PPE to avoid hair contamination. 3) Cleanse hair with running water once doffing PPE. Wash hair before taking a shower. Lower the head and keep eyes, nose and mouth off contaminated water. 4) The temperature of water for hair cleansing should be the same as for shower. Massage scalp and hair with fingertips instead of scratching with fingernails. 5) Sustained scalp disorders or gradual worsening should be treated under the guidance of dermatologists in time.

(2). Suggestions on detergents for cleansing hair/scalp

a). If hair or scalp is contaminated by patients' blood, body fluid or secretion, disinfect immediately with 75% ethanol and then cleanse with ordinary shampoo. b). If hair or hair is not exposed to contaminated environment, ordinary shampoo alone is sufficient.

Skin is the outermost barrier of human body. HCWs fighting against COVID-19 are prone to the damage of skin and mucosa barrier. In order to minimize skin and mucosa barrier breakdown, HCWs should adhere to standards on wearing protective equipment and avoid over-protection. At the same time, measures of skin care are recommended during work. This consensus provides professional advices on prevention and management of mild skin disorders. Nevertheless, timely referral to dermatologists is necessary if dermatoses are sustained or worsened gradually.

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