



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



COVID-19: Important Updates and Developments
Edited by Franco Rongioletti, MD, and Leonard J. Hoenig, MD

Changing gears: Medical gloves in the era of coronavirus disease 2019 pandemic



Jasmine Anedda, MD, Caterina Ferreli, MD*, Franco Rongioletti, MD, Laura Atzori, MD

Dermatology Clinic, Department of Medical Sciences and Public Health, University of Cagliari, Cagliari, Italy

To the Editor:

The current coronavirus 2019 disease (COVID-19) pandemic has greatly changed our perspective of the risk for infection from contact, and the use of personal protective devices (PPDs) usually reserved for health care workers (HCWs) has spread to the general population, sometimes indiscriminately. As a result, medical glove stock has been depleted, but most of all medical gloves have become a source of medical concern.^{1–4}

The World Health Organization (WHO) has warned about the limited protective efficacy of gloves. There is high risk for infection spread with their incorrect use that could instead favor the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Regular use of gloves for daily activities may lead to a false sense of protection and to an increased risk for self-contamination. This would involve the involuntary touching of the face or the spreading of fomites to desks, phones, and computers keyboards. A study has found that viruses can survive on gloves for 2 to 4 hours.⁵

Appropriate use of gloves

Hand-to-face contact has a substantial role in upper respiratory tract infections,^{6,7} although COVID-19's main way of transmission remains symptomatic person-to-person through respiratory droplets.^{1–4} The Centers for Disease Control and

Prevention (CDC) and the European Center for Disease Prevention and Control (ECDC) have recently provided guidance to regulate the use of gloves both in the health care setting and in the community.^{2,4} In the context of the COVID-19 pandemic (Table 1), gloves are recommended when caring for confirmed or suspected COVID-19 patients, especially when there is the risk of contact with body fluids (eg, blood, wound care, aerosol-generating procedures).

Hand protection with gloves is essential in any medical procedure, because skin cleaning/disinfection alone does not remove all pathogens, especially when the contamination is considerably high. Nonsterile disposable gloves should be prioritized, and ECDC alerts that no direct evidence documents an increased protection against COVID-19 through glove use, compared with proper hand hygiene alone. Meticulous hand hygiene with water and soap or by alcohol-based hand rub solutions is not avoided by the use of gloves.

There are many different types of gloves, depending on the level of protection, tactility, risk of allergy, or cost (Table 2). Although biohazard risk requires frequent glove changing, the extended use of gloves, decontamination with hand disinfectants, and reuse are frequent.⁸ All of this should be avoided, because effects of hand sanitizers are tested on the skin, whereas application on gloved hands affects gloves' mechanical properties. In a recent investigation,⁹ the application of 70% ethanol or 63% isopropanol commercial disinfectants reduced the tensile strength of latex and nitrile gloves, with a higher impact on nitrile gloves. Elongation did not change much with latex gloves, but nitrile gloves were affected. There are additional concerns about permeability, as alcohol can permeate any type of glove after 10 minutes. Some types of gloves are permeated at 2 minutes, and repeated exposure to disinfectants can increase the permeability of the

* Corresponding author. Tel.: 393 408 918 912.
E-mail address: ferreli@unica.it (C. Ferreli).

Table 1 Actual recommendations for medical glove use amid the COVID-19 pandemic

Health care workers	Reducing microbial contamination from hand contact with blood and other body fluids Containing the risk of transmission from the health care worker to the patient and vice versa Containing the risk of germ dissemination to the environment and from one patient to another
In the community	Providing care to someone sick, especially if making contact with organic fluids Cleaning and disinfecting the person, and surfaces frequently touched in the environment Removing gloves after any contact with the patient, before touching other surfaces Handwashing before and after removing the gloves. Gloves wearing never substitute handwashing and sanitization Wearing gloves while running errands is not recommended

gloves. Alcohol is inactivated in the presence of organic matter, which can easily remain on used gloves, thus potentially driving the viral transmission.

Observations and recommendations

Extended length gloves are not necessary when providing care to suspected or confirmed COVID-19 patients. They are not specifically recommended, except for activities with increased risk, such as submerging hands into a solution. For standard procedures, it is sufficient to cover the cuff (wrist) of the gown while donning.¹⁻⁴

Another common measure that is no longer recommended is “double gloving,” except for surgical procedures that carry a high risk of disrupting the integrity of the glove. Double gloving seems to increase the incidence of dermatologic side

effects, from irritation and overhydration to induction of latex allergy. The increase of skin damage as the consequence of overzealous PPD use and hand hygiene is an emergent consequence of the COVID-19 handling.¹⁰⁻¹²

About 74.5% of front-line COVID-19 HCWs developed hand dermatitis in the Chinese experience.¹³ A questionnaire-based study suggested that 88.5% of skin reactions on the hands are associated with the use of latex gloves.¹⁴ Three types of adverse events might occur: latex allergy, talcum powder reactions, and irritant dermatitis. Excluding latex allergy and powder within the gloves, the problem of excessive dryness and pruritus, associated with irritant dermatitis, may be aggravated by occlusion, leading to sweating and/or overhydration. This then may increase the permeability to sanitizers or detergents, creating a vicious cycle, plus aggravation of hand dermatitis.¹²

A peculiar pattern of hand dermatitis has been recognized, characterized by erythema and fine scaling on the palms and

Table 2 Different glove materials and characteristics

Type of glove	Indication
Latex	Used in maneuvers with high biological risk, that is, when it is necessary to handle blood or body fluids in a repeated or prolonged way Good protection against pathogen High tensile stretch, best fit and sense of touch, extremely flexible Contraindicated in latex allergy; should not be used with organic soils, oils, gas, or grease
Nitrile	Alternative to latex, especially if allergic to latex, for high-biological-risk procedures Moderate protection against pathogens High puncture and chemical resistance; good comfort, soft and flexible, but stiffer than latex More-expensive option
Vinyl–polyvinyl	Use in case of low biological risk (low protection against pathogens), for patient cleaning activities Food prep (low heat) Average resistance to chemicals (alcohols), low tensile strength Less-expensive option
Polyethylene	Only maneuvers where one-handed and short-lasting sterility is required (intravesical catheterization, endotracheal aspiration) Loose fit, ideal for frequent glove change, but low protection against hazardous materials Very economical
Synthetic gloves	Latex- and polyvinyl-free surgical or diagnostic gloves Very loose, no protection against pathogens Least-expensive option
Rubber or neoprene	Used to prepare surgical instruments and endoscopes for disinfection, cleaning of environments High mechanical resistance

Note: Gloves used for household activities in the community, although made of the same materials (eg, gloves made from natural latex, nitrile, vinyl, and polyethylene) usually do not meet the standards described for medical gloves that are used in health care.

web spaces.¹⁵ This may be attributed to the depletion of surface lipids, resulting in deeper penetration of detergents, and progressive damage of skin layers is a major pathogenetic mechanism. Irritant contact dermatitis is more commonly found with iodophors, chlorhexidine, chloroxylenol, triclosan, and alcohol-based products, whereas allergic contact dermatitis develops due to quaternary ammonium compounds, iodine or iodophors, chlorhexidine, triclosan, chloroxylenol, and alcohol sensitization.

To date, there have been no verified reports of COVID-19 infection as direct consequence of skin damage. Angiotensin-converting enzyme 2 (ACE2), which is the main cell receptor for SARS-CoV-2 entry, can be expressed in the basal layer of the epidermis, hair follicles, and eccrine glands, as well as on skin blood vessels.¹⁶

Basic skincare measures should be taken to avoid the risk of SARS-CoV-2 entry through the skin.^{10–15} Careful hand skin drying and hypoallergenic hand cream/emollients may be employed to prevent trapping sanitizers in the web spaces. Emollients may also be applied at other times to correct any residual dryness and scaling, or with the occurrence of hand dermatitis, topical corticosteroids are indicated.

A final consideration is the generation of massive amount of medical waste, caused in part by the extensive use of PPDs.¹⁷ HCWs, together with the general population, are using more gloves than ever before, whereas it should be limited to very essential preventive measures.

Conclusions

Medical gloves remain an essential part of the infection-control strategy; however, caring for patients with COVID-19 has pointed out the need for more accuracy and respect of novel guidance. Prolonged use of gloves, outside of direct patient contact, might be self-defeating rather than protective. Hand dermatitis is an emerging concern. At this time, the U.S. Food and Drug Administration has not cleared, approved, or authorized any medical gloves for specific protection against the virus that causes COVID-19 or prevention of COVID-19 infection.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. World Health Organization. Glove use information leaflet. https://www.who.int/gpsc/5may/Glove_Use_Information_Leaflet.pdf?ua=1. Accessed August 24, 2020.
2. Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19): gloves (updated April 30, 2020). <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/gloves.html>. Accessed August 24, 2020.
3. Food and Drug Administration. Medical gloves for COVID-19 (updated June 10, 2020). <https://www.fda.gov/medical-devices/personal-protective-equipment-infection-control/medical-gloves-covid-19>. Accessed August 24, 2020.
4. European Centre for Disease Prevention and Control. *Technical report. Use of gloves in healthcare and non-healthcare settings in the context of the COVID-19 pandemic*. Stockholm: European Centre for Disease Prevention and Control. 2020.
5. Kwok YLA, Gralton J, McLaws ML. Face touching: a frequent habit that has implications for hand hygiene. *Am J Infect Control* 2015;43:112-114.
6. Bertsch RA. Avoiding upper respiratory tract infections by not touching the face. *Arch Intern Med* 2010;170:833-834.
7. Casanova L, Rutala WA, Weber DJ, et al. Coronavirus survival on health-care personal protective equipment. *Infect Control Hosp Epidemiol* 2010;31:560-561.
8. Kampf G, Lemmen S. Disinfection of gloved hands for multiple activities with indicated glove use on the same patient. *J Hosp Infect* 2017;97:3-10.
9. Gao P, Horvatin M, Niezgoda G, et al. Effect of multiple alcohol-based hand rub applications on the tensile properties of thirteen brands of medical exam nitrile and latex gloves. *J Occup Environ Hyg* 2016;13:905-914.
10. Singh M, Pawar M, Bothra A, et al. Overzealous hand hygiene during the COVID 19 pandemic causing an increased incidence of hand eczema among general population. *J Am Acad Dermatol* 2020;83:e37-e41.
11. Atzori L, Ferreli C, Atzori MG, et al. COVID-19 and impact of personal protective equipment use: from occupational to generalized skin care need. *Dermatol Ther* 2020, e13598, <https://doi.org/10.1111/dth.13598>. [Epub ahead of print].
12. Cavanagh G, Wambier CG. Rational hand hygiene during the coronavirus 2019 (COVID-19) pandemic. *J Am Acad Dermatol* 2020;82:e211.
13. Yan Y, Chen H, Chen L, et al. Consensus of Chinese experts on protection of skin and mucous membrane barrier for health-care workers fighting against coronavirus disease 2019. *Dermatol Ther* 2020, e13310, <https://doi.org/10.1111/dth.13310>. [Epub ahead of print].
14. Hu K, Fan J, Li X, et al. The adverse skin reactions of health care workers using personal protective equipment for COVID-19. *Medicine* 2020;99, e20603.
15. Lan J, Song Z, Miao X. Skin damage among healthcare workers managing coronavirus disease-2019. *J Am Acad Dermatol* 2020;82:1215-1216.
16. Hamming I, Timens W, Bulthuis MLC, et al. Tissue distribution of ACE2 protein, the functional receptor for SARS coronavirus. A first step in understanding SARS pathogenesis. *J Pathol* 2004;203:631-637.
17. Saadat S, Rawtani D, Hussain CM. Environmental perspective of COVID-19. *Sci Total Environ* 2020;728, 138870, <https://doi.org/10.1016/j.scitotenv.2020.138870>.