

REVIEW

Hand hygiene during COVID-19: Recommendations from the American Contact Dermatitis Society

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The recent COVID-19 pandemic has resulted in increased hand hygiene and hand cleansing awareness. To prevent virus transmission, the Centers for Disease Control and Prevention recommends frequent hand washing with soap and water. Hand hygiene products are available in a variety of forms, and while each of these formulations may be effective against COVID-19, they may also alter skin barrier integrity and function. As health care workers and the general population focus on stringent hand hygiene, the American Contact Dermatitis Society anticipates an increase in both irritant contact and allergic contact hand dermatitis. Alcohol-based hand sanitizers with moisturizers have the least sensitizing and irritancy potential when compared to soaps and synthetic detergents. This article provides an overview of the most frequently used hand hygiene products and their associations with contact dermatitis as well as recommendations from the American Contact Dermatitis Society on how to treat and prevent further dermatitis. (J Am Acad Dermatol <https://doi.org/10.1016/j.jaad.2020.07.057>.)

Key words: allergic contact dermatitis; COVID-19; detergents; hand washing; irritant contact dermatitis; soap.

The recent COVID-19 pandemic has resulted in worldwide hand hygiene and hand cleansing awareness. Hand hygiene is a widely accepted principle in the prevention of disease transmission because proper hand hygiene has a 24% to 31% likelihood of decreasing the spread of transmissible disease.^{1,2}

COVID-19, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), is an enveloped, unsegmented, positive-sense RNA virus.³ According to the Centers for Disease Control and Prevention (CDC), the virus is currently believed to spread via direct contact, indirect contact, and

droplet contact. To prevent virus transmission, the CDC recommends frequent hand washing with soap and water for 20 seconds; alternatively, if soap and water are unavailable, hand sanitizer containing at least 60% alcohol can be used.⁴

Hand hygiene products are available in various forms: liquid or bar soaps, synthetic detergents, antiseptic handwashes, and alcohol-based hand sanitizers (ABHSs). Although each formulation may be effective against COVID-19, they may alter skin barrier integrity and function, increasing the risk of hand dermatitis. Here, experts from the American Contact Dermatitis Society (ACDS) review best hand

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hygiene practices to mitigate COVID-19–related skin disease.

TYPES OF HAND HYGIENE PRODUCTS

Soaps

Soaps are made of lye and natural fats. The term *soap* is used to refer to any cleanser; however, this is incorrect because *soap* designates a specific chemical composition.⁵ Soap is created when a fat interacts with an alkali, resulting in a fatty acid salt with cleansing properties. The typical pH of a true soap is approximately 9 to 10.⁶ Soap removes dirt and inactivates viruses by disrupting the lipid membrane and intracellular lipids. There is evidence to support soap as a more effective method of hand hygiene than hand sanitizer.⁷ Hand washing with soap and water has the added benefit of physically washing away debris and pathogens with running water. Although soaps are effective in removing debris, they also remove beneficial intracellular lipids and damage proteins found in the stratum corneum layer of the skin.⁶ Removing these beneficial lipids and proteins compromises the stratum corneum and increases skin sensitivity and irritation.⁶

Synthetic detergents

Synthetic detergents, derived from petrolatum mixed with surfactants, contain less than 10% soap and have a pH of 5.5 to 7, which is similar to the pH of healthy skin.⁶ Synthetic detergents contain chemical surfactants, which function similarly to soap. The hydrophobic end of synthetic surfactants fuses with the lipid membrane of the virus.⁸ This leads to disruption of the viral membrane but may also remove natural lipids found in the stratum corneum.⁵ Synthetic detergents have been shown to be efficacious in the killing of lipid-enveloped viruses and most protozoa. However, they are ineffective against non–lipid-enveloped viruses. COVID-19, a lipid-enveloped virus, should therefore be susceptible to synthetic detergents.^{9–11} Examples of common surfactants in synthetic detergents include sodium lauroyl sarcosinate, cocamide diethanolamine, sodium lauroyl oat amino acids, disodium cocoamphodiacetate, decyl glucoside, sodium cocoyl glutamate, lauryl glucoside, and cetrimonium chloride.⁹ A subset of synthetic

detergents are the lipid-free cleansers. Lipid-free cleansers contain no soap (no fat or oil), clean without water, and leave a thin moisturizing residue containing glycerin or glycol.^{6,12}

Many synthetic detergents contain added lipophilic moisturizing ingredients (eg, petrolatum, vegetable oils, shea butter).⁵ The addition of mois-

turizing ingredients to synthetic detergent cleansers allows for effective skin cleansing with minimal stripping of the essential stratum corneum components.⁶ The degree of induced skin xerosis, irritation, and inflammation depends on the specific surfactant concentrations.⁶

Antiseptic handwashes

Antiseptic handwashes are soaps or synthetic detergents that have an added antimicrobial component. These antimicrobial ingredi-

ents disrupt the integrity of the viral membrane.^{13,14} Various antimicrobial ingredients were reviewed and rated for their relative efficacy as a virucidal agent and potential allergenicity (Table I). Alcohols, bleach, and iodophor-containing solutions are the most effective against viruses.¹⁵ The antiviral activity of alcohol is attributed to its ability to denature proteins.¹⁶ The antiviral activity of povidone iodine is noted to rapidly penetrate the cells of microorganisms, inactivate cellular replication, and impair protein synthesis.¹⁷

ABHS

ABHSs work by penetrating the viral membrane to denature and coagulate proteins, disrupt cellular metabolism, and induce lysis of the viral particle.¹⁴ In 2017, a study evaluated the virucidal activity of ABHSs against a variety of viral pathogens, including SARS-CoV. This study determined that ethanol-based and isopropyl ABHSs were effective disinfectants during the previous 2002 SARS-CoV outbreak.¹⁸ With respect to COVID-19, the CDC recommends that ethanol greater than 60% or isopropanol greater than 70% be used on the hands in health care.¹⁹ Isopropyl alcohol percentage is calculated by weight or by volume. For example, 70% alcohol by weight is equivalent to 76.8% by volume if prepared at 15°C or 80.5% if prepared at 25°C.¹³ Additionally, the CDC recommends ABHSs that contain emollients or moisturizers with low allergenicity, as discussed in articles by Rodriguez-Homs and Atwater²⁰ and Xu

CAPSULE SUMMARY

- Hand hygiene is an accepted practice to prevent the transmission of infectious disease.
- Increased hand washing related to coronavirus 2019 may result in elevated rates of hand dermatitis.
- The American Contact Dermatitis Society recommends best practices for proper hand hygiene, skin disease prevention, and skin restoration.

Abbreviations used:

ABHS:	alcohol-based hand sanitizer
ACD:	allergic contact dermatitis
ACDS:	American Contact Dermatitis Society
CDC:	Centers for Disease Control and Prevention
ICD:	irritant contact dermatitis
SARS-CoV-2:	severe acute respiratory syndrome coronavirus 2
TEWL:	transepidermal water loss

et al,²¹ as an alternative to harsher soaps and detergents, to minimize irritant contact dermatitis (ICD).^{21,22} With respect to hand dermatitis, well-formulated ABHSs conferred lower rates of ICD compared to other hand hygiene methods, such as soap and water.¹⁶

Disinfectant wipes

Disinfectant wipes are commonly used for disinfection. Hand wipes and baby wipes are formulated for skin use. These wipes contain antibacterial active ingredients, such as benzethonium chloride or alcohol, to disinfect. Hand wipes containing antimicrobial ingredients break down the COVID-19 virus by disrupting the viral membrane. Similarly, alcohol-based hand wipes also degrade the integrity of the viral membrane in the same method as ABHS, making them a viable opponent to COVID-19.

Appropriate use of wipes is necessary for skin ICD to be avoided. Wipes designed for surface cleaning should not be used on the skin. The wipes commonly sold by household disinfectant companies use harsh active ingredients such as *N*-alkyl dimethyl benzyl ammonium chloride as their antimicrobial agents. Due to the harsh disinfectants being documented as sources of chemical irritation, they should not be used in hand hygiene.²³

SKIN BARRIER FUNCTION

A major component of a healthy skin barrier is the stratum corneum, composed of keratin and lipids. The epidermis maintains an acidic cutaneous pH (acid mantle) that provides structural integrity and buffers against harsh environmental substances that can negatively affect skin barrier function, including alkaline soaps and detergents, hot water (and very cold water), low humidity, repeated glove use, friction, wet work, and rough paper towels.²⁴ Stringent hand hygiene can cause an acute loss of surface lipids due to lipid-emulsifying detergents and lipid-dissolving alcohols.¹³ As the lipid barrier of the stratum corneum is depleted and proteins are

denatured, the attenuated skin barrier will exhibit increased transepidermal water loss (TEWL) and increased epidermal penetration of irritants and allergens, propagating an inflammatory response, resulting in hand dermatitis.²⁵ With respect to the inflammatory response, topical steroids may be necessary to mitigate inflammatory skin disease. However, topical steroids can also have direct implications related to epidermal barrier function. These include epidermal atrophy, reduced keratinocyte size, decreased free fatty acids, and increased TEWL.²⁶

HAND HYGIENE-INDUCED DERMATITIS

As health care workers and the general population focus on stringent hand hygiene, the ACDS anticipates an increase in both ICD and ACD. During the COVID-19 outbreak in China, 66.1% of health care workers washed their hands more than 10 times per day, but only 22.1% applied moisturizers after hand washing.^{2,27} The higher frequency of hand washing in contrast with the lower frequency of moisturizer application provides an imbalance that predisposes to an increased risk of hand dermatitis.

ICD

ICD risk secondary to hand hygiene increases relative to the concentration, duration, and intensity of contact with the eliciting substance. The majority of occupational skin diseases are due to contact dermatitis, with ICD being the most common cause (80% of cases).^{28,29} In a study in which occupational dermatitis was evaluated in health care workers, the hands are most commonly affected. This most likely occurred because frequent hand washing, gloves, disinfectants, and detergents are known irritants.³⁰ Health care workers are in one of the highest-risk professions for developing occupational skin disease, with an estimated prevalence of 30%.³⁰

A combination of chemical and physical irritants (eg, detergents and hot water) results in keratinocyte release of proinflammatory cytokines that instigate skin barrier disruption, cellular changes, and additional cytokine release. Reported irritants include iodophors, antimicrobial soaps (chlorhexidine, chloroxylenol, triclosan), detergents, alcohol-based products, and other additives in hand cleansing products. Use of detergent-based substances leads to the highest rates of dermatitis by reducing moisture in the stratum corneum and stripping away protective lipids, thereby making the skin more vulnerable to irritation.³¹ ABHSs are believed to be safer than detergents with regard to risk of ICD because of lesser lipid-dissolving effects.^{13,18} ABHSs with moisturizers may result in a decreased risk of ICD versus hand sanitizer without

Table I. Activity of antimicrobial ingredients against enveloped viruses such as coronaviruses

Ingredient	Virucidal activity against enveloped viruses ^{11,43*}	Allergenicity [†]
Chloroxylenol	High	+
Ethanol	High	-
Povidone iodine	High	+/-
Sodium hypochlorite (bleach) (0.21%)	High	-
Triclosan/triclocarban	High	+/-
Benzalkonium chloride	Moderate	+
Chlorhexidine digluconate	Moderate	+
Benzethonium chloride	Low	-
Phenolic compounds	Low	-
Quaternary ammonium compounds	Low	-

*High virucidal activity: <1 minute; moderate virucidal activity: 1 to 30 minutes; low virucidal activity: >30 minutes.

†The + symbol indicates that the ingredient is found in the American Contact Dermatitis Society core patch testing panels, +/- indicates scattered reports of contact allergy and the - symbol indicates that allergenicity is rare.^{15,16}

Table II. Allergens commonly encountered with regular hand hygiene

Gloves ^{30,32}	Soaps, synthetic detergents, and antiseptics ^{33*}	Hand sanitizers ²⁷
I. Latex	III. Fragrance	V. Preservatives
II. Rubber accelerators	IV. Surfactants	Fragrance
• Thiurams	• Cocamidopropyl betaine	• Dimethyloldimethyl hydantoin
• Carbamates	• Cocamide diethanolamine	• Diazolidinyl
• Diphenylguanidine	• Decyl glucoside	• Formaldehyde
• Mixed dialkyl thioureas	• Dimethylaminopropylamine	• Iodopropynyl butylcarbamate
• Benzothiazoles	• Oleamidopropyl dimethylamine	• Imidazolidinyl urea
		• Isothiazolinones
		• Quaternium-15
		Benzoates
		Cetyl stearyl alcohol
		Tocopherol

*These allergens were the top North American Contact Dermatitis Group screening allergens found in skin cleansers for the years 2000 to 2014.³³

moisturizer. It is imperative to check the ingredients of products to prevent hand dermatitis.

Allergic contact dermatitis

Allergic contact dermatitis (ACD) is a risk with frequent hand washing. The development of contact allergy requires sensitization to a specific allergen, followed by elicitation of the inflammatory response upon secondary exposure to the allergen. There are a variety of hand hygiene components reported to cause hand ACD, including preservatives, surfactants, and antimicrobial ingredients (Tables I and II).³²⁻³⁵ ABHSs may also contain allergens, including propylene glycol and fragrance.³² Most health care facilities have switched to nitrile gloves to avoid sensitization to latex. However, rubber accelerators are still used in the manufacturing of nitrile gloves and are a common causes of glove ACD. Vinyl gloves are considered to be safer with respect to ACD, because they usually do not contain rubber accelerators; however, there are rare reports of ACD to vinyl gloves.³⁶⁻³⁸ Furthermore, the CDC reports that nitrile, natural rubber, and neoprene (polychloroprene) gloves all maintain greater minimum tensile and elongation requirements when compared to vinyl



Fig 1. Hand dermatitis from antiseptic hand wash in a health care worker.

gloves.^{33,39} Therefore, medical gloves made of neoprene or nitrile may be implemented as rubber-free options that also protect against viral exposure.^{33,38}

Individuals exposed to hand hygiene-related irritants or allergens may experience any 1 of the following morphologic patterns of ICD or ACD: acute (erythema, edema, vesicle formation) (Fig 1), subacute (crust formation, scaling), and chronic (lichenification). Those with recalcitrant hand dermatitis, a change in baseline hand dermatitis, a

Table III. American Contact Dermatitis Society hand hygiene recommendations**Use of soaps and synthetic detergents**

- Wash hands with lukewarm or cool water and soap for at least 20 seconds.
- Avoid hot and very cold water.
- Nonfrictional, pat drying (don't rub).
- Immediate application of moisturizer after cleansing practices is recommended.
- Products with antibacterial ingredients are not necessary for proper hand hygiene.
- Look for soaps or synthetic detergents that are devoid of allergenic surfactants, preservatives, fragrances, or dyes.
- Look for synthetic detergents with added moisturizers.
- Dry hands are common with frequent use of soaps or synthetic detergents.

Use of ABHS

- At least 60% alcohol is recommended.
- Look for hand sanitizers that are devoid of allergenic surfactants, preservatives, fragrances, or dyes.
- Look for ABHSs with added moisturizers.
- Dry hands are common with frequent use. Application of a moisturizer after hand washing is recommended.

Use of moisturizers

- Avoid moisturizers in jars to prevent double dipping into and potentially contaminating the product.
- Use moisturizers packaged in tubes instead.
- Look for pocket-sized moisturizers to keep on one's person for frequent reapplication.
- At night, apply moisturizer followed by cotton or loose plastic gloves (eg, plastic clear, disposable food gloves) to create an occlusive barrier.
- For health care workers, a moisturizer under gloves can also be effective. Moisturizers with a water base are safe under all gloves; however, oil-based moisturizers can break down latex and rubber by making the material swell or become brittle.
- Latex, vinyl, and nitrile gloves are resistant to breakdown from ethanol or isopropyl alcohol.
- Soak and smear: soak the hands in plain water for 20 minutes and immediately apply moisturizer of choice to damp skin nightly for up to 2 weeks.

Glove ACD

- For glove ACD, accelerator-free gloves should be used, such as rubber-free neoprene or nitrile gloves.
- Apply moisturizer after washing hands and before wearing gloves.
- Consider a cotton glove liner or loose plastic gloves (eg, plastic clear, disposable food gloves).
- Individuals with suspected hand ACD should be patch tested.

Treatment of hand dermatitis

- ACD
 - For hand dermatitis that is allergic in nature, allergens should be identified and avoided.
 - Application of a topical steroid may be recommended to mitigate flares of dermatitis.
 - Individuals with recalcitrant hand dermatitis should seek a dermatology consultation and be evaluated for patch testing.
 - Individuals with suspected ACD should be patch tested to evaluate for a clinically relevant causal allergen.
 - For recalcitrant cases, a stronger topical steroid, phototherapy, systemic therapy, or occupational modification may be necessary.
- ICD
 - For hand dermatitis that is irritant in nature, awareness of the irritating nature of wet work and exposure to surfactants and detergents is imperative.
 - Irritants should be identified and avoided.
 - The use of barrier creams (eg, restorative creams such as humectants) may be helpful; however, their use is equivalent to regular moisturizers.
 - Switching to less-irritating products should be attempted.
 - Application of a topical steroid can be considered if conservative measures fail; however, consider potential topical steroid-induced damage to the skin barrier.
 - Individuals with recalcitrant hand dermatitis should seek a dermatology consultation.
 - For recalcitrant cases, phototherapy, systemic therapy, or occupational modification may be necessary.

Risk factors for induction or worsening of hand ACD and/or ICD

- Hand washing
 - Frequent hand washing
 - Washing hands with dish detergent or other known irritants
 - Washing hands with very hot or very cold water
 - Use of disinfectant wipes to clean hands
 - Working with known irritants such as bleach

Table III. Cont'd

- Application of known allergens
 - Products containing topical antibiotics (eg, neomycin, bacitracin)
 - Applications of superglue (ethyl cyanoacrylate) to glue inflammatory or healing fissures
 - Occluding fingers with adhesive bandage impregnated with bacitracin or benzalkonium chloride
- Occlusion
 - Increased duration of glove occlusion (without underlying moisturizer application)
 - Hands treated with a detergent or soap before glove occlusion (without underlying moisturizer application)
 - Occluding hands with self-adherent wraps
- Underlying skin disease
 - Pre-existing atopic dermatitis of the hands
 - Picking at dermatitis-induced scale

ABHS, Alcohol-based hand sanitizer; ACD, allergic contact dermatitis; ICD, irritant contact dermatitis.



Fig 2. One fingertip unit. Two fingertip units is the appropriate amount of moisturizer to apply to hands after hand washing.

new hand dermatitis, or suspect contact allergy should seek dermatologic care and should be considered for patch testing.

MOISTURIZERS

Moisturizers both prevent and treat xerosis and dermatitis due to hand hygiene.²⁴ Moisturizers can be categorized into different formulations, including ointments, creams, lotions, and gels. In general, ointments are considered the most moisturizing, with creams, lotions, and gels following, respectively. Those with severe xerosis or eczema should consider ointment.

Moisturizing ingredients include occlusive, humectant, emollient, and protein rejuvenators. Occlusives (eg, petrolatum, beeswax) serve as a physical barrier to decrease TEWL, resulting in the replenishment of stratum corneum water content. Humectants (eg, urea, glycerin), are effective hydrophilic compounds that attract water from the deeper dermis and the outside environment of the epidermis.⁴⁰ This newly attracted moisture decreases TEWL, improving the skin barrier. Emollients (eg, ceramides, free fatty acids) are primarily lipids and oils that replenish the disrupted lipid outer membranes to prevent skin dehydration. Protein

rejuvenators (eg, collagen, keratin) are small-molecular-weight proteins that are thought to replenish essential skin barrier proteins lost in hand hygiene. Soaps can be irritating and cause dryness to the skin. Adding a humectant to this formula can help mitigate skin irritation. Barrier creams and regular moisturizing lotions have been shown to be equivocal in the prevention of ICD, and either may be used after hand washing.¹³ A combination of these ingredients is effective to replenish skin barrier integrity and function.

BEST PRACTICES AND ALTERNATIVES

To mitigate the expected rise in dermatitis from repetitive hand washing in response to COVID-19, good hand hygiene techniques are imperative. The CDC recommends that individuals wash their hands with soap and lukewarm water for at least 20 seconds.⁴ Special attention is required to equally wash all areas of the hand. Results from Wong et al⁴¹ showed that the fingertips, hypothenar eminence, and dorsum of the hand were commonly missed areas in hand washing. Particular care during hand washing should be directed toward these missed areas. An extensive list of ACDS-recommended hand hygiene practices can be found in [Table III](#).

Water temperature does not affect microbe removal; therefore, it is recommended that cold or lukewarm water be used to avoid skin irritation.^{4,42} Higher water temperatures (greater than 40°C) affect the stratum corneum by lipid fluidization, or disordered lipid structure, leading to increased skin permeability.⁴³ Washing hands with soap and water immediately before or after using an alcohol-based product is unnecessary and increases the risk of hand dermatitis. Applying gloves when hands are still wet from either hand washing or alcohol sanitizer is also

not recommended, because the risk for skin irritation due to trapping of irritating ingredients increases.¹³ A full list of exacerbating hand dermatitis factors is provided in Table III.

Universal precautions should be used because many COVID-19—positive patients may be asymptomatic. For health care professionals, hands should be washed both before and after patient encounters using a strong ABHS and antiseptics with antiviral activity.^{13,22}

To effectively use moisturizing agents after hand washing and nonfrictional (pat) drying, apply a minimum amount of 2 fingertip units of moisturizer to each hand, as shown in Fig 2. Evenly spread a thin layer across the hand, between fingers, on cuticles, and on fingertips and wait 1 to 3 minutes before resuming activity. Moisturizer should be reapplied every 3 to 4 hours and/or after each hand washing. The American Academy of Dermatology recommends fragrance-free moisturizers with petrolatum or mineral oil as the most effective and least allergenic.^{13,44} Additionally, further recommendations about low-allergenicity products can be found in the literature (Xu et al²¹ and Rodriguez-Homs and Atwater²⁰), but product selection is ultimately based on user preference and tolerability. Of note, petrolatum and mineral oils should not be used under latex or rubber medical gloves, because these products are known to compromise glove integrity.⁴⁵ However, latex, vinyl, and nitrile gloves are resistant to breakdown from ethanol or isopropyl alcohol.^{46,47}

CONCLUSION

Hand hygiene is essential for reducing COVID-19 transmission. There are a variety of hand hygiene products available; however, their safety and efficacy vary. With respect to hand dermatitis, ABHSs with moisturizers have the least sensitizing and irritancy potential compared to soaps and synthetic detergents. Wet work and synthetic detergents may be the greatest contributors to hand dermatitis because of the potential inclusion of surfactant, preservative, or fragrance allergens. Strategies for hand dermatitis prevention include using products devoid of common allergens, using products with added moisturizers, and applying moisturizers immediately after hand washing or before glove occlusion. Cases of recalcitrant hand dermatitis should be evaluated and managed by a dermatologist.

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