International Journal of Biomedicine 12(2) (2022) 204-208
http://dx.doi.org/10.21103/Article12(2)_RA6

REVIEW ARTICLE

INTERNATIONAL JOURNAL OF BIOMEDICINE

Hand Sanitizers Containing Alcohol and their Effects on the Skin during the COVID-19 Pandemic

Ramadan S. Hussein*

Department of Internal Medicine, College of Medicine, Prince Sattam Bin Abdulaziz University Alkharj, Saudi Arabia

Abstract

COVID-19 is a contagious disease with a high case fatality and morbidity rate associated with a pandemic outbreak. Transmission of SARS-CoV-2 infection can take place via airborne transmission, droplet, or direct contact. Implementing effective preventive measures remains the most important option available for dealing with SARS-CoV-2. The effectiveness of surface disinfectants, sanitizers, and personal protective equipment is totally based on three factors—strength, composition, and material—to determine whether or not preventive measures will be effective. Coronavirus transmission is disrupted by the use of an alcohol-based sanitizer containing 62% to 95% alcohol, which can denature viral proteins. However, hand sanitizers and disinfectants used on a regular daily basis may harm the skin's surface. In this study, we cover the importance of selecting the right disinfectant, the proper method of hand sanitization, and how to minimize the harmful effects on the skin while enhancing the inhibitory activity that could be a viable prescription for fighting COVID-19.(**International Journal of Biomedicine. 2022;12(2):204-208.**)

Key Words: SARS-CoV-2 • alcohol-based hand sanitizers • contact dermatitis

For citation: Ramadan S. Hussein RS. Hand Sanitizers Containing Alcohol and their Effects on the Skin during the COVID-19 PandemicInternational Journal of Biomedicine. 2022;12(2):204-208. doi:10.21103/Article12(2)_RA6

Abbreviations

ABHS, alcohol-based hand sanitizers; **ACD**, allergic contact dermatitis; **HS**, hand sanitizer; **ICD**, irritant contact dermatitis.

Introduction

The World Health Organization (WHO) has declared a global emergency in response to a current, unexpected COVID-19 outbreak in China.[1,2] SARS-CoV-2, a single-stranded RNA virus, has the largest genomic configuration among all RNA viruses, with a genome size of 26-32Kb.[3] In the case of coronavirus, the bat is the most likely primary host to transmit viral infections, which is why it is called a zoonotic virus. Vaccination and antiviral drug therapy are the first lines of defense in the fight against viral infections, according to the WHO. The inability to obtain effective antiviral drug therapy against COVID-19 is now exacerbating the situation to a greater extent.

Infection prevention and control, according to WHO guidelines, is an evidence-based and practical approach to prevent avoidable infections from harming patients and health workers. According to statistics,[4] infection control programs contributed to significant reductions of healthcare-associated infections by 30%.

Because of the worldwide crisis that the COVID-19 pandemic has created, infection prevention and control are the most important remaining opportunities for preventing the outbreak of viral infection. The transmission of SARS-CoV-2 infection can take place through airborne and droplet transmissions, or direct contact. To reduce the spread of COVID-19, it is necessary to implement appropriate preventive measures, such as the habitual applications of

***Corresponding author:** Dr. Ramadan S. Hussein. Department of Internal Medicine, College of Medicine, Prince Sattam Bin Abdulaziz University, Alkharj, Saudi Arabia. E-mail: ramadangazeera@yahoo.com*

effectual rubs, hand sanitizers, and soaps, as well as special defending tools (appropriate face/eye guards, a proper grown, and fitted masks). The alcohol-based sanitizer dissolves the lipid's membrane, denatures the proteins of microorganisms, and inactivates them. But at the same time, the regular use of hand disinfectants may hurt the skin of the hands.

The goal of this review was to investigate the efficiency of alcohol-based hand sanitizers (ABHS) against the coronavirus infection in humans, as well as unpleasant influences and commendations to reduce the negative impact of the hand sanitizer (HS) on the skin.

This review was carried out in accordance with the PRISMA checklist.[5] It was based on prior research published in English databases such as PubMed and Google Scholar in scientific articles published between 2000 and 2021 with the keywords "hand washing," "skin impact," "alcohol," and "hand sanitizers." The information extracted from each study included the study's primary characteristics, such as study design, year of publication, and the primary author's name. We selected articles from a large number of reports in accordance with the effectiveness of HS and the possible consequences of using them during the current COVID-19 pandemic.

SARS-CoV-2 Infection

SARS-CoV-2 belongs to the genus Betacoronavirus, which are enclosed, affirmative single-strand RNA viruses with similar morphology.[6] Lipid solvent, involving ether and ethanol, can deactivate these viruses (75%). The SARS-CoV-2 infection causes coughing, breathlessness, and fever. Surfaces of inanimate and animate items could be responsible for SARS-CoV-2 transmission, but the main mode of transmission is human to human. SARS-CoV-2 transmission occurs through droplets, coughing, contaminated hands and surfaces, and other means.[6,7]

COVID-19 & Preventive Care

Among the most important precautionary measures are the use of personal preventive equipment (face and eye protectors and well-fitting masks), good hand hygiene, and effective surface disinfectants. However, frequent handwashing with water and soap, or disinfecting hands with alcohol-based sanitizers that were recommended by WHO, can help to reduce the risks of COVID-19 transmission from an infected person to others. WHO has issued instructions to local manufacturers concerning HS production.[8]

Types, Mechanism of Action, and Recommended Concentrations of ABHS

The WHO recommends two preparations containing ethanol or isopropyl alcohol. The first contains isopropyl alcohol (99.8%), and the second - ethanol (96%). Alcohol's sanitizer/biocidal power varies with its type and strength. Alcohol's biocidal action is interrupted by microbial exterior protein coagulation; a 90% alcohol concentration instantly coagulates the microbial proteins.[8] Adding various inorganic or organic acids, including phosphoric acid, fumaric acid, peroxyacetic acid, L-lactic acid, citric acid, or lactic acid, to an alcohol-based disinfectant can increase its efficacy against various viruses. As a result of the inadequate dissolution of organic substances into free ions, their lipophilic character and capacity to permeate the infected biomolecules, along with their propensity to cause hazardous effects, rise.[9] Isopropyl alcohol (70%-72%) and ethanol (60%-70%) are preferred as disinfectants/biocidal agents because of their predetermined concentration ranges. Disinfectant/biocidal agents used in hand sanitizers have been shown to improve considerably the effectiveness of hand hygiene.[9]

Skin Anatomy and Physiology

The three skin layers are the superficial epidermis, the middle dermis, and the innermost hypodermis. Additionally, the skin protects the body from mechanical trauma and water loss while also protecting against microbial invasion. The stratum corneum, the outermost layer of the epidermis, serves as the primary barrier between the body and the environment. The epidermis is composed of keratinized, stratified squamous epithelium.[10] The squamous cell layer is involved in the transfer of certain substances in and out of the body. The stratum corneum is the cornified layer of the skin consisting of 15–30 sheets of corneocytes (cornified keratinocytes).[10] As lamellar bodies are exocytosed during keratinocyte terminal differentiation, these lipids will occupy the cellular components between the corneocytes and help maintain the epidermal protective barrier.[11] The squamous cell layer also contains cells called Langerhans cells. These cells attach themselves to antigens that invade damaged skin and alert the immune system to their presence.[12,13] The epidermis also contains melanocytes producing melatonin, which colors skin and shields it from the sun's UV rays.

As well as acting as a barrier to harmful microbes, the skin is home to numerous helpful bacteria, notably *Aureus epidermis*, *Staphylococcus*, *Micrococcus* spp., *Mycobacterium* spp., and *Corynebacterium* spp.[14] By competing for nutrition or boosting the skin's defense system, these bacteria may provide colonization resistance against harmful microorganisms. Under normal circumstances, microbes are not harmful. However, they could become virulent if the skin flora distribution is interrupted, such as by frequent hand washing or lengthy use of topical agents.[15,16] In order to decrease the occurrence of infection, the microbial equilibrium is reached and preserved through continuous skin regeneration. The process takes around 28 days, beginning with the process of mitosis of the basal epithelium and ending with a desquamating stage. When keratinocytes are leached off from the epidermis, the microorganisms that colonize the surface of the skin are removed. Bacterial invasion is kept to a minimum as microbial populations grow in a balanced manner.

Impact of Alcohol-Based Sanitizer on the Skin

When using alcohol-based hand sanitizers regularly, specific safety methods should be considered. The sebaceous glands on the skin's surface secrete oil that is comprised of free fatty acids, particularly lauric and sapienic acids, which have intrinsic antiviral action.[17] ABHS that is regularly used

may remove natural oil from the surface of the skin, leading to a reduction in antiviral activity and dehydration of the skin. In addition, skin dehydration is typified by cracked cuticles, which could provide pathogens with effortless access to deep skin layers, resulting in the promotion of microbial infection. Aside from that, the potential for fire hazards associated with ABHS is an inescapable associated factor for the skin. Additionally, ABHS is known to cause allergic reactions. Irritant contact dermatitis (ICD) and allergic contact dermatitis (ACD) are the two most frequent skin responses associated with ABHS use. ICD symptoms can range from mild to severe, with manifestations such as dryness, pruritus, erythema, and bleeding being common. ACD symptoms can be mild and localized or severe and widespread, depending on the severity of the disorder.[18]

There are a number of possible causes for adverse reactions to alcohol-based preparations, including sensitivity to a contaminant, carbonyl compounds, or other excipients such as perfumes, benzyl alcohols, parabens, or benzalkonium chloride.[19] HS and other hand hygiene products can sometimes damage the skin through such effects as neutralization of the endothelium proteins and changes in intercellular lipids, as well as a decrease in corneocyte cohesiveness and water-binding ability of stratum corneum.[20] The most severe problem is the degradation of the lipid shield, specifically with prolonged exposure to liposome cleansers and lipid-dissolving alcohols, which may infiltrate deep skin layers and modify the epidermal ecology, culminating in more recurrent migration by microbes.[21]

Ethanol Impact on the Skin

The well-known disinfectant ethanol is used in a variety of applications. Because of a scarcity of current research, it is still unclear whether it could be a cause of skin cancers as a consequence of penetrating the skin layers.[22] Contact of the epidermis with an ethanol-based hand disinfectant is related to a low level of systematic toxicity.[23]

As a result of the wide range of individual reactions and tolerance levels to ethanol, determining the level of a toxic dose of ethanol-based hand rub can be difficult. When ethanol is applied to immature skin in infants and young children, it can cause reactions as well as systemic toxic effects.[24] When ethanol comes into contact with the skin or eyes, it can cause irritation and an allergic reaction, while extended contact can cause cracking or dehydration of the skin, as well as peeling, redness, and itching.[25]

The study by Kramer et al.[26] was designed to assess dermal ethanol incorporation through disinfection and surgical hand hygiene, as well as to quantify absorption levels in human subjects. According to the findings of this study, dermal absorption of ethanol-based hand sanitizers was below toxic levels in humans and could therefore be safe.

Isopropyl Alcohol Impact on the Skin

A dose of roughly 0.5–1 ml/kg of 70% isopropyl alcohol-based sanitizers is considered toxic, but the exact amount varies according to the individual's tolerance level to the substance.[27] An acute toxic response to dermal exposure will occur at a concentration of LD50 >2000 mg/kg. Isopropanol absorption through the skin can cause skin irritation, and extended and recurrent experience can result in dryness, redness, itching, and rash on the skin.[28]

Augmented Risks of Other Viral Infections

Sanitizers have long been used around the world as a disinfectant to improve hand hygiene. Extreme uses of alcohol-based sanitizers as a coronavirus protective method increase the permeability of the skin, deprive the skin of water and oil, and cause irritation and roughness of the skin. Damage to and dehydration of the skin creates a breeding ground for various disease-rooting bacteria, increasing the risk of viral entrance into the skin and, as a result, indirectly increasing the risk of infection through skin dysfunctions.[25]

Antimicrobial Fight Originated by Frequent Hand Sanitizer Application

In the era of the coronavirus pandemic, frequent use of hand sanitizers has become mandatory as a preventive measure.[25] But there is also the risk that microbes that have been repeatedly exposed to disinfectants or other genotoxic chemicals are more likely to develop mutations as a result of natural selection, making them more resistant to the effects of these sanitizers. Antimicrobial resistance increases the workload of already overburdened healthcare professionals.[29]

Recommendations to Prevent or Minimize the Cutaneous Adverse Effects Several methods, either individually or in combination, can be used to prevent or minimize the negative effects of sanitizers, including choosing products that contain fewer irritants, humidifying the skin after sanitizing hands, and refraining from engaging in behaviors that might aggravate or cause skin irritations.[30-32] Instead of using alcohol or certain antiseptic soaps, ABHS including emollients or humectants could be applied to avoid the drying and irritant effects of these products.[32] The healthcare and elderly employees who frequently dress in fitted gloves are more susceptible to having dehydrated, irritated skin than the general public. As a result, lotions comprising oils, fats, or humectants should be used by those at high risk of developing skin conditions. It is important to increase the amount of emollient when living in a cold, dry climate.[33] Ethanol has the lowest alcohol-based effect on skin irritation.[34]

Conclusion

Hand hygiene is one of the significant, imperative and infection control measures against the transmission of SARS-CoV-2. As a result of the speedy efficiency and activity in destroying coronaviruses, ABHS is becoming increasingly popular. Choosing ABHS with some of the proper alcohol and using appropriate hand hygiene procedures during hand washing is critical to ensuring that all microbes are successfully eradicated with the least impact on the skin. The use of emollients in conjunction with sanitizers may help to reduce skin irritation. The irritant contact dermatitis and allergic contact dermatitis associated with ABHS, on the other

hand, are the decisive harmful effects that need to be explored in greater depth.

Acknowledgments

This publication was supported by the Deanship of Scientific Research at Prince Sattam Bin Abdulaziz University.

Competing Interests

The authors declare that they have no competing interests.

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