Hand Hygiene in Clinical Settings: a Primer on Hand Hygiene Regimens and Their Effect on Skin Condition

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Key Points:

- Healthcare workers are at increased risk for occupational dermatitis as a result of the high number of opportunities for hand hygiene during patient care.
- Alcohol-based hand rub is perceived as being more damaging to skin than soap and water, but the evidence is clear that hand washing has considerably more negative effects on the skin's epidermal barrier.
- Healthcare workers may need to change their hand hygiene practices to see a skin benefit.
- An intensified effort by healthcare facilities to increase hand hygiene highlights the need to closely evaluate hand hygiene products for both efficacy and skin impact.
- If poorly formulated hand hygiene products are selected, it could have an adverse impact on healthcare worker acceptance, skin condition, and hand hygiene compliance.

Introduction

Healthcare-acquired infections (HAI) are a global problem and in the United States alone, it is estimated that 1 in every 20 patients will acquire such an infection, resulting in 99,000 deaths per year.[1,2] The Centers for Disease Control and Prevention (CDC) have long cited hand hygiene as the primary means to reduce HAI[3] and published studies demonstrate that healthcare facilities that have successfully increased hand hygiene compliance have seen a simultaneous decrease in healthcare-associated infections.[4] Yet, hand hygiene compliance rates remain unacceptably low.[5]

Major factors contributing to the lack of adherence to hand hygiene protocols include the high number of hand hygiene opportunities per hour of patient care, wearing gowns and gloves, and hand-washing agents causing irritation and dryness.[6]

Major factors contributing to the lack of adherence to hand hygiene protocols include the high number of hand hygiene opportunities per hour of patient care, wearing gowns and gloves, and hand-washing agents causing irritation and dryness.[6] With the advent of alcohol-based hand rubs (ABHR) and their widespread adoption in healthcare facilities after the publication of the CDC's Guideline for Hand Hygiene in Health-Care Settings in 2002 and the World Health Organization's (WHO) Guidelines for Hand Hygiene in Health Care in 2009, virtually all hospitals in the United States use ABHR as the primary method for performing hand hygiene. A focus on hand hygiene compliance by accrediting agencies, particularly The Joint Commission beginning in 2004, and Pay for Performance as a result of the Affordable Care Act, has placed expectations on healthcare facilities to create programs around hand hygiene and improve compliance.

Because hand hygiene is viewed as the cornerstone of infection prevention, much effort has gone into not only increasing hand hygiene compliance on the part of healthcare facilities, but developing better products and methods for measuring compliance by industry. Few environments are impacted more by topical product usage than healthcare facilities. In a large hospital study of healthcare worker (HCW) hand hygiene practices, it was estimated that HCWs could clean their hands in an ICU setting approximately 20 times per patient hour.[7] Based upon that calculation, during one 12-hour shift an ICU nurse could have as many as 240 opportunities to perform hand hygiene. Skin products are normally tested at frequencies ranging from 18-20 times per day,[8,9] which is more representative of heavy consumer use. Little is known about the skin effects of these products when applied at very high frequencies. The purpose of this white-paper is to provide an overview of the structure and function of the skin's epidermis, hand hygiene products used in healthcare, and the effects of these products on skin health.

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Structure and Function of the Skin

The skin is the largest organ of the human body. Its essential functions are to provide a first line of defense from pathogens and the elements, help protect contents of the body underneath it, help regulate body temperature, and permit the sensations of touch, heat, and cold. The primary barrier of the skin is the stratum corneum (SC), the outermost layer of the epidermis. This extremely thin but tough outer membrane is the interface of our body with the external world and as a result it can be easily damaged. It can be considered a 'brick wall' where the 'bricks' are keratin-filled corneocytes and the 'mortar' is composed of specialized lipids. The purpose of the epidermis is to limit passive water loss from the body, reduce absorption of chemicals from the environment, and prevent microbial infection.[10] Although the SC limits water loss through the skin, some water does escape. This built in water loss is essential for SC functioning and to keep its outer layers moisturized. Water normally diffuses around the 'brick' or corneocytes as they are called. However, the bricks are lost one-at-a-time daily in a highly orchestrated enzymatic process called desquamation.

Hand washing, which can include elements of water, surfactants, antiseptic agents, friction, and towel drying coupled with subsequent occlusion from gloves, can affect the skin.

When the skin becomes dry and flaky, this process is disturbed and the skin surface 'bricks', the corneocytes, remain attached to the underlying layers giving the appearance of skin scaling. Dryness can be induced by low humidity or as a result of using soaps and surfactants, which can disturb the structure of the 'mortar' leading to impaired barrier function. Now the skin's barrier can be breached and chemicals can transverse the skin's barrier to the underlying living layers of the skin and impair its functioning.

The use of water alone, without any other product, can dry the skin through removal of intrinsic moisturizing factors within the SC. Hand washing, which can include elements of water, surfactants, antiseptic agents, friction, and towel drying coupled with subsequent occlusion from gloves, can affect the skin. In addition, environmental stressors such as low relative humidity, using hot water, and low quality of paper towels can also affect the skin.[11]

Soaps and surfactants can cause dissolution of the SC lipids and disturb the lamellar architecture. The binding of surfactants to keratin within the corneocytes of the SC, together with the high pH of the soap and/or water used for washing, leads to the barrier becoming compromised and the skin becoming dry, scaly, and irritated. Because of this, the normally highly selective SC barrier now allows for penetration of ingredients that it would normally be resilient to.

Hand hygiene Products and their Effects on the Skin in Healthcare Workers

Occupational dermatitis is a significant health issue in the US healthcare system with costs estimated between $222 million to $1 billion.[12] Up to 85% of nurses are reported to have had histories of dermatitis symptoms.[13] The most common type of skin reaction associated with hand hygiene is irritant contact dermatitis. Symptoms of irritant contact dermatitis include dryness, irritation, itching, cracking, and bleeding.[11] This has implications not only for the HCW, but also for the patient. In published studies examining damaged skin among HCW, there was an increase in the bacterial load on hands with a subsequent disruption in healthy microbial flora, leading to an increase in the amount of pathogens of HAI significance.[14,15]

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A study with over 1800 nurses found that 69.5% of nurses believed ABHRs to be more damaging than hand washing, compared to 30.5% who believed hand washing to be more damaging than ABHRs.[16] When considering separate hand hygiene regimens of soap and water versus an ABHR hand gel, a crossover study lasting six weeks (2834 observed opportunities for hand washing) reported that the ABHR gel

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regimen did not adversely impact skin condition whereas the soap and water regimen had a dramatic negative effect, namely irritation and dryness.[17] Even though this was a low frequency-of-use trial with just over three hand hygiene episodes per hour worked, it highlights the relative mildness of ABHRs versus soap and water.

Hand washes are mixtures of detergents, surfactants and antiseptic agents which can have considerable effects on the skin's epidermal barrier.[12] Hand washing, which contributes to impaired skin barrier or heightened trans-epidermal water loss, has been shown to result in stinging, burning, pruritus, dryness, and scaling.[18,19] Hand washing, even though it may be the source of the problem, can be perceived as soothing. ABHR can elicit symptoms that are an indicator of the problem, such as stinging or burning, when the skin is already damaged and specific nerve receptors are activated. Because there is less of a sensorial response to hand washing, HCW's response to the pain felt when using an ABHR is to continue the cycle of hand washing, thereby exacerbating the problem. The opportunity, therefore, is to maintain and repair the skin's barrier and not expose the nerves to begin with.

Most alcohol-based hand rubs consist of 62-70% volume/volume alcohol, a thickening or foaming agent (depending on whether it is in gel or foam format), and a small amount of emollients and/or skin conditioners. There are a few products

available that have been clinically proven to provide some skin care benefits. While providing a clinical benefit, some of these products can sometimes also be perceived as having an unacceptable sticky or tacky feel. This tacky buildup, caused by the increased level of skin conditioners, can also inhibit daily tasks and gloving, which may result in more frequent hand washing, and the cycle continues. It is important to evaluate the science behind hand hygiene products for efficacy, skin tolerance and aesthetics. The challenge is to find products that deliver optimal skin disinfection while ensuring the skin's barrier is fully functional and does not elicit a HCW's perception of problems with use of other products. Such products need to cause no harm and secondly help repair any damage to the skin induced during the cleansing process.

Conclusion

Alcohol-Based Hand Rubs (ABHR) together with hand soaps play a significant role in healthcare strategies to reduce the incidence of HAI. Healthcare workers are at greater risk than the general public for developing skin irritation as a result of hand hygiene regimens, but there are few disciplines where hand hygiene is more essential. The misconception that hand sanitizing is more damaging to skin than hand washing is still prevalent despite ABHR products' presence in healthcare facilities for over a decade. Healthcare workers with compromised skin need to try to replace as many hand washings as indications allow with ABHRs to stop the cycle of skin damage from hand washing and to allow the skin to slowly improve its natural barrier function. As pressure to improve hand hygiene compliance continues to increase, there may be potential for unforeseen skin issues. It is important for healthcare providers to research the formulations they are evaluating for both efficacy and skin tolerance to determine the best possible products to help facilitate improved compliance. Finally, more study needs to occur around different product formulations and their effect on skin, especially in higher compliance environments. All of this will give healthcare providers the confidence to select and use products that will actually help improve hand hygiene and not unintentionally increase the problem meant to be solved.

Healthcare workers with compromised skin need to try to replace as many hand washings as indications allow with ABHRs to stop the cycle of skin damage from hand washing and to allow the skin to slowly improve its natural barrier function.

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Biography

Anthony V. Rawlings, BSc (Hons), Ph.D., FRSC, FSB, HonMSCS

Director, AVR Consulting, Ltd.

Professor Rawlings brings over 25 years of experience in research and development and research in skin biology at several senior management levels in food and personal care companies in the UK and USA. He is the author/co-author of over 200 papers, book chapters, and abstracts and has filed over 50 patents in areas of skin and food science. He has received several literature awards from the dermatology and cosmetic communities.

He is ex-Chief Editor of the International Journal of Cosmetic Science, was the Co-Chair of the Gordon Research Conference on Mammalian Barrier Function in 2007 and is visiting Professor at UCL. He is co-editor of the first and second editions of "Skin Moisturization" published in 2002 & 2009, respectively, and "Acne and Its Therapy."

He is an expert in skin biology and especially stratum corneum biology, the interactions of cosmetic ingredients and clinical together with objective testing methods.

He lives in Northwich with his wife Ann.

Todd J. Cartner, BSME

Senior Skin Care Scientist, GOJO Industries

Todd Cartner has worked in science, technology, and engineering for almost 30 years. He has lead GOJO Skin Bioengineering, Sensory Descriptive Testing, Consumer Acceptance Testing, and Dermatological Clinical Testing for over 10 years. Todd received his bachelor of science in Mechanical Engineering from the University of Akron and pursued postgraduate studies in Computer Science with a focus on data modeling. He has a passion for photography and digital imaging which applies to numerous high throughput, noninvasive testing applications. His skill set includes method development to evaluate and screen hand hygiene products and regimens for long-term, high-frequency applications. Todd began working in Research and Development for GOJO in 1998.

Biography

Amanda J. Copeland, BS

Senior Product Development Scientist, GOJO Industries

Amanda Copeland has worked in the personal care industry for almost 10 years with the majority of her focus on developing new hand-sanitizing products for the Healthcare industry. Amanda received her bachelors of science in Chemistry from Penn State Behrend. She has a passion for addressing the needs of healthcare workers that ladder up to the higher meaning of saving lives and making life better. Her skill set includes integration of innovative skin care technologies into products and development of new methods to deliver breakthrough claims. Amanda began working in Research and Development for GOJO in 2006.

Megan J. DiGiorgio, MSN, RN, CIC

Clinical Specialist, GOJO Industries

Megan DiGiorgio has worked in infection prevention for 10 years, spending the last eight years at the Cleveland Clinic in Cleveland, Ohio. Megan received her bachelors of science in nursing and masters of science in nursing from Case Western Reserve University. Megan has a background in pediatric nursing in addition to her infection prevention experience. She published an article in the journal Infection Control and Hospital Epidemiology, reflecting her work around a definition for central-line associated bloodstream infection (CLABSI) in the hematology-oncology population, which garnered the attention of the Centers for Disease Control and Prevention (CDC). Megan worked with the CDC on their creation of a new subset of CLABSI called "mucosal-barrier injury," which was reflected in the updated 2013 surveillance definitions for specific types of infections. She has presented posters and oral abstracts at several national conferences, and is active in her local northeast Ohio Association of Professionals in Infection Control chapter, serving as president in 2012. Megan began working at GOJO in 2013 as a Clinical Specialist for Healthcare.

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[1]Healthcare Personnel Handwash Study #111016-101, March 19, 2012, BioScience Laboratories, Bozeman, MT.

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