

# Skin reactions related to hand hygiene and selection of hand hygiene products

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**Background:** In October 2004, The World Health Organization (WHO) launched the World Alliance for Patient Safety. Within the alliance, the first priority of the Global Patient Safety Challenge is to reduce health care-associated infection. A key action within the challenge is to promote hand hygiene in health care globally as well as at the country level through the campaign "Clean Care is Safer Care." As a result, the WHO is developing Guidelines on Hand Hygiene in Health Care, designed to be applicable throughout the world.

**Methods:** This paper summarizes one component of the global WHO guidelines related to the impact of hand hygiene on the skin of health care personnel, including a discussion of types of skin reactions associated with hand hygiene, methods to reduce adverse reactions, and factors to consider when selecting hand hygiene products.

**Results:** Health care professionals have a higher prevalence of skin irritation than seen in the general population because of the necessity for frequent hand hygiene during patient care.

**Conclusion:** Ways to minimize adverse effects of hand hygiene include selecting less irritating products, using skin moisturizers, and modifying certain hand hygiene practices such as unnecessary washing. Institutions need to consider several factors when selecting hand hygiene products: dermal tolerance and aesthetic preferences of users as well as practical considerations such as convenience, storage, and costs. (*Am J Infect Control* 2006;34:627-35.)

Patient safety is a crucial component of health care. Confronted with the important issue of patient safety, the 55th World Health Assembly in 2002 adopted a resolution urging countries to pay the closest possible attention to the problem and to strengthen safety and monitoring systems. The resolution requested that the World Health Organization (WHO) take a lead in building global norms and standards and supporting country efforts in developing patient safety policies and practices. In May 2004, the 57th World Health Assembly approved the creation of an international alliance to improve patient safety as a global initiative,

and the World Alliance for Patient Safety was launched in October 2004. The alliance is focusing its actions on the following areas: the Global Patient Safety Challenge, patients for patient safety, taxonomy, research, solutions for patient safety, and reporting and learning.<sup>1</sup> Together, the combined efforts of all these components have the potential to save millions of lives and, through improvement of basic procedures, to halt the diversion of a significant amount of resources from other less productive uses.<sup>2</sup>

The topic chosen for the first Global Patient Safety Challenge is health care-associated infection. A key action within the challenge is to promote hand hygiene in health care globally as well as at the country level through the campaign "Clean Hands are Safer Hands."<sup>1,2</sup> Hand hygiene, a very simple action, reduces infections and enhances patient safety across all settings. To provide health care workers, hospital managers, and health authorities with the best scientific evidence and recommendations to improve practices and reduce health care-associated infections, the WHO has developed Guidelines on Hand Hygiene in Health Care (advanced draft). The present article represents the current state of the work related to the impact of hand hygiene on the skin of health care workers, which has been conducted by dedicated experts consulted within the framework of the development of these guidelines.

To achieve a high rate of hand hygiene adherence, health care workers need an understanding of infectious disease risk, clear guidelines, education, and access to acceptable hand hygiene products.<sup>3-10</sup> The

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selection of effective and acceptable handcleansing agents is a key component of hand hygiene promotion. A major determinant of effectiveness is antimicrobial profile. A major determinant of compliance is user acceptance, in particular addressing the potential for skin damage or the fear of such harm related to use of hand hygiene products.<sup>11</sup> The purpose of this article is to describe skin reactions associated with hand hygiene, discuss ways to minimize them, and identify factors to consider when selecting hand hygiene products.

## SKIN REACTIONS RELATED TO HAND HYGIENE

There are 2 major types of skin reactions associated with hand hygiene. The first and most common is irritant contact dermatitis with symptoms that include dryness, irritation, itching, cracking, and bleeding. The second, allergic contact dermatitis, is rare and results from an allergy to an ingredient in the hand hygiene product. Symptoms of allergic contact dermatitis can be mild and localized or severe and generalized. In the most serious form, there may be respiratory distress and other symptoms of anaphylaxis. These 2 conditions can be difficult to differentiate.

### Frequency and pathophysiology of irritant contact dermatitis

In one study, approximately 25% of nurses reported symptoms or signs of dermatitis on their hands, and 85% gave a history of skin problems.<sup>12</sup> Frequent and repeated use of hand hygiene products, particularly soaps and other detergents, are an important cause of chronic irritant contact dermatitis among health care professionals.<sup>13</sup> Cutaneous adverse reactions were infrequent among health care workers (13/2750) exposed to an alcohol-based preparation containing chlorhexidine gluconate and skin emollient during a hand hygiene program.<sup>14</sup> This equated to 1 cutaneous adverse event per 72 years of health care workers' exposure. The variable potential of detergents to cause skin irritation can be reduced by adding emollients and humectants. Antimicrobial soaps may cause irritation because of the antimicrobial agent or to other ingredients of the formulation. Symptoms and signs include dryness, burning sensation, skin that feels "rough," erythema, scaling, and fissures. An example of a hand skin self-assessment tool is given in Table 1.

Denaturation of *stratum corneum* proteins, changes in intercellular lipids (either depletion or reorganization of lipid moieties), decreased corneocyte cohesion, and decreased *stratum corneum* water-binding capacity are all mechanisms of damage.<sup>13,15</sup> Among these, the main concern is the depletion of the lipid barrier through contact with lipid-emulsifying detergents and lipid-dissolving alcohols.<sup>16</sup> Frequent handwashing progressively

depletes surface lipids. Detergents then penetrate into the superficial skin layers. With dry climatic conditions or habitually dry skin, this lipid depletion occurs more quickly.<sup>16</sup> Damage to the skin also changes skin flora, resulting in more frequent colonization by staphylococci, yeast, and gram-negative bacilli.<sup>17,18</sup>

Although alcohols are often less damaging than detergents,<sup>19</sup> they can also cause dryness and skin irritation.<sup>20,21</sup> The lipid-dissolving effect of alcohols is inversely related to their concentration.<sup>16,21</sup> Irritant contact dermatitis is more commonly reported with iodophors.<sup>22</sup> Other antiseptic agents that may cause irritant contact dermatitis include chlorhexidine, chloroxylenol, triclosan, and alcohol-based products. Skin that is damaged by repeated exposure to detergents may be more susceptible to irritation by all types of hand antiseptic formulations, including alcohol-based preparations.<sup>23</sup> Graham et al reported low rates of cutaneous adverse reactions to an alcohol-based handrub (isopropanol 70%) formulation containing chlorhexidine (0.5%) with emollient.<sup>14</sup>

Manufacturers sometimes provide information on the irritancy potential of commercially prepared hand hygiene products. This is often determined by measuring transepidermal water loss when using the preparation. Using hot water for handwashing, incomplete drying of hands, and quality of paper towels can all contribute to dermatitis. Low relative humidity (most common in winter months in the Northern Hemisphere) associated with failure to use supplementary hand lotion or cream contribute to dermatitis with both handrubbing and washing.<sup>24,25</sup> Shearing forces when wearing or removing gloves and allergy to latex proteins are also risk factors for hand dermatitis among health care workers.<sup>16</sup>

### Allergic contact dermatitis related to hand hygiene products

Allergic reactions to products applied to the skin (contact allergy) may present as delayed-type reactions (allergic contact dermatitis) or less commonly as immediate reactions (contact urticaria). The most common causes of contact allergies are fragrances and preservatives, with emulsifiers being less common triggers.<sup>26-29</sup> Liquid soaps, hand lotion, ointments, or creams used by personnel may contain ingredients that cause contact allergies.<sup>27,28</sup>

Allergic reactions to antiseptic agents including quaternary ammonium compounds, iodine or iodophors, chlorhexidine, triclosan, chloroxylenol and alcohols<sup>26,30-39</sup> as well as possible toxicity in relation with dermal absorption of products<sup>40,41</sup> have been reported. Allergic contact dermatitis because of alcohol-based handrubs is, however, very uncommon.

**Table I.** Example: Hand skin self-assessment tool

On a scale of 1-7, rate the current condition of the skin on your hands									
Appearance									
Abnormal: red, blotchy, rash	1	2	3	4	5	6	7	Normal: no redness, blotching, or rash	
Intactness									
Many abrasions or fissures	1	2	3	4	5	6	7	Completely intact. No abrasions or fissures	
Moisture content									
Extremely dry	1	2	3	4	5	6	7	Normal amount of moisture	
Sensation									
Extreme itching, burning, or soreness	1	2	3	4	5	6	7	No itching, burning, or soreness	

Surveillance at a large hospital in Switzerland, where a commercial alcohol-based handrub has been used for more than 10 years, failed to identify a single case of documented allergy to the product.<sup>42</sup> In late 2001, a freedom of information request for data in the Food and Drug Administration (FDA)'s Adverse Event Reporting System (<http://www.fda.gov/cder/aers/default.htm>) regarding adverse reactions to popular alcohol-based handrubs in the United States yielded only one reported case of an erythematous rash reaction attributed to such a product (John M. Boyce, MD, personal communication). There are few reports of allergic dermatitis resulting from contact with ethanol<sup>43-45</sup> and one report of ethanol-related contact urticaria syndrome.<sup>46</sup> More recently, Cimiotti et al reported adverse reactions associated with an alcohol-based handrub preparation. In most cases, nurses who had symptoms were able to resume use of the product after a brief interruption in use.<sup>39</sup> This study does raise the possibility of skin reactions because of alcohol-based handrub preparations, which may have resulted from additives to the alcohol.<sup>26,31,47-51</sup>

**METHODS TO REDUCE ADVERSE EFFECTS OF AGENTS**

There are 3 primary strategies for minimizing hand hygiene-related irritant contact dermatitis among health care personnel: selection of less irritating hand hygiene products; education regarding proper skin care management, and routine use of moisturizing skin care products.

**Selecting less irritating products**

Because health care personnel must cleanse their hands frequently, it is important for health care facilities to provide products that are both efficacious and as safe as possible to the skin. The tendency of products to cause skin irritation and dryness is a major factor that influences acceptance and ultimate usage by staff.<sup>4,5,52-55</sup> For example, concern about the drying effects of alcohol has been a major cause of poor acceptance of alcohol-based handrubs in hospitals.<sup>56,57</sup>

Staff perception is therefore important. Although many hospitals have provided personnel with plain soaps with the hope of minimizing dermatitis, frequent use of such products has been associated with even greater skin damage, dryness, and irritation than some antiseptic preparations.<sup>19,22,53</sup> One strategy for reducing exposure of staff to irritating soaps and detergents is to promote the use of alcohol-based handrubs containing emollients. Several studies have demonstrated that such products are tolerated better and are associated with better skin condition when compared with either plain or antiseptic hand products.<sup>3,9,16,19,53,58-61</sup> With alcohol-based handrubs, the shorter time required for hand antisepsis may itself increase acceptability and compliance.<sup>62</sup> It is important to note that in settings in which the water supply is unsafe, waterless hand antisepsis presents additional advantages over soap and water.<sup>63</sup>

**Reducing hand hygiene practices that can cause irritation**

Certain hand hygiene practices can also reduce the risk of skin irritation. For example, routinely washing hands with soap and water immediately before or after using an alcohol-based product is not only unnecessary but may lead to dermatitis. Additionally, donning gloves while hands are still wet from either washing or applying alcohol increases the risk of skin irritation. For these reasons, health care workers should be reminded not to wash routinely their hands before or after applying alcohol and to allow their hands to dry completely before putting on gloves. In fact, a recent study demonstrated that education regarding proper skin care management was effective in preventing occupational skin disorders.<sup>64</sup> No product, however, is free of potential risk. Hence, it is usually necessary to provide an alternative for use by individuals with sensitivity or reactions to the hand hygiene product available in the institution.

**Use of moisturizing skin care products**

The effects of hand hygiene products on skin vary considerably, depending on environmental factors

such as weather and other external conditions. For example, in tropical countries and during the summer months in temperate climates, the skin remains more moisturized than in cold, dry environments. The effects of products on the skin also vary by skin type. In one recent study, nurses with darker skin were rated as having significantly healthier skin and less skin irritation than nurses with light skin, both by their own self-assessment as well as by observer rating.<sup>65</sup> Results of a prevalence survey of 282 Chinese hospital nurses suggested that hand dermatitis was less common among this group when compared with those in other parts of the world.<sup>66</sup> The need for moisturizing products will subsequently vary across health care settings, geographic locations and respective climate conditions, and individuals.

For health care personnel who are at risk for irritant contact dermatitis and other adverse reactions to hand hygiene products, additional skin moisturizing offers a relatively simple solution. Hand lotions and creams often contain humectants, fats, and oils that increase skin hydration and replace altered or depleted skin lipids that contribute to the barrier function of the skin.<sup>15,67</sup> Several controlled trials have shown that regular use of such products can help prevent and treat irritant contact dermatitis caused by hand hygiene products.<sup>68-70</sup> Importantly, in the trial by McCormick et al,<sup>69</sup> improved skin condition resulting from frequent and scheduled use of an oil-containing lotion led to a 50% increase in hand cleansing frequency among health care workers. These investigators emphasized the need to educate personnel regarding the value of regular, frequent use of hand care products.

Recently, barrier creams have been marketed for the prevention of hand hygiene-related irritant contact dermatitis. Such products are absorbed to the superficial layers of the epidermis and are designed to form a protective layer that is not removed by standard hand-cleansing. Evidence of the efficacy of such products, however, is equivocal.<sup>68,69,71</sup> Furthermore, such products are expensive. Therefore, their use in health care settings, particularly when resources are limited, cannot be recommended at this time without further research.

Frequent wearing of gloves can increase the risk of skin problems. In a study among healthy volunteers, when a moisturizer was applied prior to wearing occlusive gloves, there was a statistically significant improvement on skin hydration.<sup>72</sup> More recently, an examination glove coated with aloe vera resulted in improved skin integrity and decreased erythema in 30 women with occupational-associated dry skin.<sup>73</sup> However, such products cannot yet be recommended because further field trials, larger sample sizes, and cost analyses are needed.

In addition to evaluating the efficacy and acceptability of hand care products, product selection committees should inquire about potential deleterious effects that oil-containing products may have on the integrity of rubber gloves and on the efficacy of antiseptic agents used in the facility.<sup>74,75</sup>

## FACTORS TO CONSIDER WHEN SELECTING HAND HYGIENE PRODUCTS

The selection of hand hygiene agents requires a multidisciplinary team effort (eg, infection control professionals, both clinical and administrative staff, pharmacists, behavioral scientists) to evaluate factors related to handcleansing agents and to conduct clinical pilot projects to test these factors.<sup>20,54,76,77-79</sup> Therefore, pilot studies to help select products at the local level should mainly address user acceptability issues. Other aspects such as tolerance, availability, storage, and costs should also be addressed locally to guarantee feasibility and sustainability.

### Pilot testing

Pilot testing to assess acceptability is strongly recommended before final selection of hand hygiene product(s). Characteristics that can affect staff acceptance of a hand hygiene product include dermal tolerance and skin reactions to the product and its fragrance, consistency, and color.<sup>22,40,54</sup> Structured self-administered questionnaires may be useful tools to assess acceptability of hand hygiene products. Such tools should, however, be adapted to the local setting because of differences in sociocultural backgrounds, weather and environmental conditions, and clinical practices among users. Skin reactions to hand hygiene products may be heightened by low relative humidity. Therefore, dry weather, eg, during winter months in the Northern Hemisphere, should be taken into account during pilot testing, and introduction of new products during dry periods, with low relative humidity, should be avoided.

Dryness and irritation should be assessed with sufficient numbers of personnel to ensure the generalizability of findings. Test products should be compared with products already in use. If more than 1 new product is to be tested, a period with the routine product should be interspersed between test periods. For replacement of an old product, the new product should be at least as good as the previous one. For an efficient comparison, each product should be tested by different users for at least 2 to 3 weeks. A shorter testing time period (minimum of 3 days) could be used among staff working in high workload conditions with a high number of opportunities for hand hygiene per hour of patient care and thus intensive use of a hand hygiene product.<sup>80-82</sup>

An inferior product could be responsible for a decrease in hand hygiene compliance. After careful evaluation of suitable hand hygiene agents, health care workers should be given the option to choose the product for use at their institution. Freedom of choice at an institutional level was rated the second most important feature reported by health care workers to improve hand hygiene compliance in an audit of a successful promotion program in Victoria, Australia.<sup>14</sup> Prior to product pilot testing, the appropriate administrative decision makers in the institution should determine which products have demonstrated efficacy and which can be obtained at the most favorable cost. Only products that have already been identified as efficacious and affordable should be tested by patient care staff.

### Selection factors

The primary consideration when selecting hand hygiene products must be efficacy, which is not discussed in this article. We suggest that readers consult the current version of the WHO Guidelines for Hand Hygiene in Health Care (advanced draft) ([http://www.who.int/patientsafety/events/05/global\\_challenge/en/](http://www.who.int/patientsafety/events/05/global_challenge/en/); accessed February 6, 2006) to access the latest recommendations regarding the efficacy of hand hygiene products. Other factors to be taken into consideration during user acceptability testing include the following:

- dermal tolerance and skin reactions;
- aesthetic preferences of personnel and patients such as fragrance, color, texture, and ease of use;
- practical considerations such as availability, dispenser convenience and functioning, and ability to prevent contamination;
- cost issues; and
- freedom of choice by health care workers at an institutional level after consideration of the above-mentioned factors.

### Dermal tolerance and skin reactions

Several studies have published methods to evaluate dermal tolerance such as dryness or irritation,<sup>16,22</sup> either by self-assessment or by expert clinical evaluation.<sup>4,8,9,53,54,58,59,83-87</sup> Some studies have confirmed that these assessment techniques correlate well with other physiologic measures such as transepidermal water loss or desquamation, tests that are not practical to use in clinical settings.<sup>9,16,53,59,85-87</sup> An example of a self-assessment tool that might be practical for use in the clinical setting is included in Table 1.

### Aesthetic preferences

**Fragrance.** Products with pronounced fragrances occasionally may lead to discomfort and respiratory

symptoms in some staff members allergic to perfumes/fragrances. Many patients complain about perfumed products, especially in oncology. Therefore, consideration should be given to selecting a product with mild or no added fragrances.

**Consistency (texture).** Handrubs are available as gels, rinses, or foams. Dermal tolerance and efficacy do not differ according to consistency.<sup>85,88</sup> Although more expensive than rinses, gels have recently become the most popular type of alcohol-based handrub preparation in many countries. Gels have better consistency than rinses, and some may produce a feeling of emollient "build-up" with repeated use or may feel slippery or "oily," which may be perceived in a negative way.

Rinses have a consistency similar to water, although a few are more viscous. They often dry more quickly than gels or foams, a potential advantage, and may be less likely to produce a feeling of emollient "build-up." They may be more likely to drip from the hands onto the floor during use, and, in some hospitals, this has created spots on the floor under dispensers. Rinses frequently have a stronger smell of alcohol than gels, but dermal tolerance is similar for both.<sup>85,87</sup>

Foams are used less frequently and are more expensive. They are least likely to drip from the hands onto the floor during application, but may produce stronger "build-up" sensation with repeated use.

Further research is needed to assess differences among products, in particular between rinses and gels, and comparing skin tolerance, user acceptability, and compliance and, ultimately, the impact on cross transmission and infection rates.

### Practical considerations

**Product accessibility and dispenser systems.** Several studies suggest that the frequency of hand cleansing is affected by the level of accessibility of hand hygiene facilities.<sup>7,60,89-94</sup> A reliable supplier (industrial or local, at the health care facility) is essential to assure a continuous supply of products. If industry-manufactured products are not available or are too costly, products may be produced within the local setting. However, it is difficult to regulate quality control of locally made products, and methods to monitor quality are needed.

For handrubbing, dispensers should be available near to the point of care. The time required for a staff member to leave a patient's bedside, go to a sink, and wash and dry their hands before attending to the next patient is a deterrent to frequent hand cleansing.<sup>62,80</sup> In contrast to conventional sinks used for handwashing, dispensers for alcohol-based handrubs do not require plumbing and can be made available adjacent to each patient's bed and at many other points of

patient care. To avoid any confusion between soap and alcohol-based handrubs, alcohol dispensers preferably should not be placed adjacent to sinks. Pocket carriage of alcohol-based handrub solutions together with availability of bedside dispensers have been associated with significant improvement in staff adherence to hand-cleansing protocols.<sup>3,93,95</sup>

Touch-free dispensers have also been associated with increased frequency of hand hygiene, although there may be additional maintenance costs for such battery-operated devices.<sup>96</sup> Such dispensers are more adapted to surgical hand antisepsis, carried out in a specific hand antisepsis room, and without risk of asepsis error.

For handwashing, soap dispensers should be placed next to the sink, but can themselves become contaminated,<sup>97</sup> and their design should permit easy decontamination. In some health care facilities, only 1 sink is available in rooms housing several patients, or sinks are located far from the patient's bedside, which may discourage hand cleansing.<sup>98</sup> In high-risk areas such as intensive care units, access to sinks may be blocked by the vast array of bedside equipment such as ventilators and intravenous infusion pumps.

Automated handwashing machines have been tested by several investigators, usually for the purpose of improving the quality or the frequency of hand cleansing, but have not been conclusively proven to produce sustainable improvement in hand hygiene practices.<sup>91,99</sup> Although technologically advanced, such devices and monitoring systems are a recent development.<sup>100</sup> As yet, there is no published evidence demonstrating that the use of these devices results in sustained improvements in hand hygiene. In addition, these machines are quite expensive, a factor that mitigates against their use in resource-poor settings.

Dispenser systems provided by manufacturers or vendors also need to be considered when evaluating hand hygiene products. Dispensers that become blocked or partially blocked and do not deliver the product or do not deliver the product onto the individual's hand appropriately may discourage use. Problematic dispensers may deter use as much as inconvenient location of product. In one hospital in which a viscous alcohol-based handrinse was available, only 65% of functioning dispensers delivered the product with 1 press of the dispenser lever, and 9% of dispensers were totally occluded.<sup>101</sup> In addition, the volume delivered was often suboptimal and sometimes squirted onto the wall instead of into staff member's hands. Dispensers should be tested before purchase to avoid these drawbacks, which can severely jeopardize attempts at improvement.

**Risk of contamination.** Alcohol-based rubs inherently have a low risk of contamination,<sup>102</sup> compared

with soap contamination, which has frequently been reported.<sup>103-108</sup> Multiple-use bar soap should be avoided because it is difficult to store bar soap dry at a sink, resulting in a subsequent increase in the risk of contamination.<sup>104-106</sup> Although liquid soaps are generally preferred over bar soaps for handwashing, the risk for either intrinsic<sup>107</sup> or extrinsic<sup>103,108</sup> microbial contamination still exists, and efforts should be made to overcome this.

**Cost.** The promotion of hand hygiene is highly cost-effective, and the introduction of alcohol-based handrub for hand cleansing is a cost-effective strategy.<sup>58,109-111</sup> Although the cost of hand hygiene products will continue to be an important issue for departments responsible for purchasing such products and is a significant consideration in resource-poor settings, the level of acceptance of products by health care professionals is of critical importance. An inexpensive product with undesirable characteristics may discourage hand hygiene among staff, resulting in poor compliance with all of the costs that this incurs in terms of infectious complications.

Interventions designed to improve hand hygiene at a national level may require significant financial and human resources, particularly multifaceted campaigns ([http://www.who.int/patientsafety/events/05/global\\_challenge/en/](http://www.who.int/patientsafety/events/05/global_challenge/en/); accessed February 6, 2006).<sup>1</sup> The economies of scale achieved by centralized design and production of supporting materials will logically result in less cost to the overall health economy. In the United Kingdom "cleanyourhands" campaign,<sup>112</sup> this approach was used. Countries without such a centralized approach and particularly where distribution networks are not established might not achieve sufficient economies of scale to make such an approach feasible without additional massive investment from the commercial sector.

## SUMMARY AND RECOMMENDATIONS

Because of the necessity for frequent hand hygiene during patient care, health care professionals have a higher prevalence of skin irritation than seen in the general population. Damaged, irritated skin is undesirable, not only because it causes discomfort and even lost workdays for the professional but also because hands with damaged skin may in fact increase the risk of transmission of infections to patients. Ways to minimize the possible adverse effects of hand hygiene include selecting less irritating products, using skin moisturizers, and modifying certain hand hygiene practices such as unnecessary washing. In addition to assessing product efficacy and assuring compliance with hand hygiene guidelines, institutions need to consider several factors when selecting hand hygiene products: dermal tolerance and aesthetic preferences

of users as well as practical considerations, such as convenience, storage, and costs. Appropriate pilot testing, product selection and user education will contribute to healthier hands of care providers and improved adherence to expected hand hygiene practices.

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