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Wet work in relation to occupational dermatitis

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Skin protection in nursing-work: promoting the use of gloves and handalcohol

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Abstract

Nursing has been identified as a wet work occupation, with a high prevalence of occupational irritant contact dermatitis. Reduction of exposure to skin irritants contributes to the prevention of occupational skin disease in nurses. The role of the use of water & soap, handalcohol and gloves in prevention programs is discussed. Two additional measures for reducing exposure to skin irritants are postulated:

- 1 Use a handalcohol in stead of water and soap in disinfection procedures, when the hands are not visibly dirty:
- 2 Use of gloves in wet activities such as patient washing, to prevent hands to become wet and visibly dirty.

We investigated the effectiveness of these recommendations in a model. Mean daily wet work exposure during nursing work was modelled: regular model. We also modelled exposure to skin irritants in combination with the implementation of these recommendations: prevention model. The hands of healthy volunteers were exposed to the regular or the prevention model during 3 weeks 5 days a week. Change in TEWL of the back of the hands was measured after 3 weeks exposure to these wet work simulations.

An increase in TEWL with the regular model, while mean TEWL decreased in the prevention model. Skin irritation from occlusion by gloves appears to be more pronounced in the regular model compared to the prevention model. The results of this study justify the conclusion that in nursing-work handalcohol is the preferred disinfectant. Although the prevention model implies increased occlusive exposure this has no additional irritating effect, probably because of the absence of soap exposure.

Introduction

Occupational skin disease is one of the most common occupational diseases in industrialised countries. Frequent and prolonged exposure to skin irritants such as water, detergents and occlusion by using gloves is a major etiological factor for developing occupational skin disease. Workers in wet work situation have an increased risk of development of an irritant contact dermatitis on their

hands⁽¹⁻¹⁰⁾. Reduction of exposure to skin irritants in wet work occupations is important in preventing occupational skin disease⁽¹¹⁾.

Nursing has been identified as a wet work occupation, with a high prevalence of occupational skin disease: most often an irritant contact dermatitis. General preventive measures for reducing exposure to skin irritants in nursing activities, with recommendation for the use of water, soap and handalcohol, have been listed^(11;12).

A handalcohol is used for hand disinfection, water and soap can be used for both disinfection and hand cleaning. The irritant effect of handalcohol on the skin in comparison to water and soap in a nursing situation is unclear⁽¹³⁾.

Nurses often wash their hands, these hand washing activities are done because of hospital hygiene regulations: prevention of spreading viruses and bacteria, but also to remove dirt. Theoretically a hand washing activity with water and soap has a greater impact on the barrier function of the stratum corneum compared to a handalcohol, because of a more pronounced disturbance of the lipid homeostasis^(12;14;15). The preference of water and soap above a handalcohol in situations where only disinfection is required is questioned^(16;17).

In an unpublished study our group compared three different handalcohols: ethanol, chloorhexidine in alcohol and isopropanol, with soap: sodium-laurylsulfate, in an occlusive as well as an open application model during 2 weeks, 4 days a week. In combination with occlusion a significant increase in TEWL was seen with the soap compared to the handalcohols in combination with occlusion.

Lubbe et al⁽¹³⁾ found a weak irritant potential for n-propanol 60%: the concentration of rub-ins often used in clinical routine, close to the irritant potential of water. They also found an increased irritancy in a setting of pre-existent or concomitant detergent-mediated barrier damage.

Cumulation of skin irritant activities in daily nursing activities and their interactions seem to be important in the etiology of hand dermatitis. In an earlier study we observed nurses on the frequency and duration of wet hands and the type of activities that caused the hands to become wet^(18;19). Based on these studies we concluded wet work in nurses is characterised by:

- frequent short-term exposures because of hand washings and patient washing activities
- sporadic use of gloves and for a short period of time

In addition to the general preventive measures in nursing activities listed by Agner and Held and the guidelines for Hand Hygiene in Health Care Settings by Boyce^(11;12;20) table 2, we postulated 2 other recommendations:

- Use a handalcohol in stead of water and soap in disinfection procedures, when the hands are not visibly dirty
- Use of gloves in wet activities such as patient washing, to prevent the hands to become wet and visibly dirty

Wet activities in nursing, excluding the occlusion by wearing gloves, were patient related activities in more than 12% in our observations. By introducing the measure of using gloves with these activities a reduction in wet work exposure could be reached in two ways:

-
- 1 Rinse your hands with lukewarm water, Rinse and dry your hands with thoroughly after washing.
 - 2 Use protective gloves when starting wet- work tasks.
 - 3 Protective gloves should be used when necessary but for as short a time as possible.
 - 4 Protective gloves should be intact and clean and dry inside.
 - 5 When protective gloves are used for more then 10 minutes, cotton gloves should be worn underneath.
 - 6 Do not wear rings at work.
 - 7 Disinfectants should be used according to the recommendations for the workplace.
 - 8 Apply moisturisers on your hand during the working day and after your work. Select a lipid rich moisturiser free from fragrances and with preservatives having the lowest allergen potential.
 - 9 Moisturisers should be applied all over the hands including fingerwebs, fingertips and back of the hands.
 - 10 Take care also when doing house work, use protective gloves for dishwashing and warm gloves when going out side in winter.
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Table 2: Skin protection program according to Agner and Held⁽²⁰⁾

- Reduction of 12% water and soap exposures is reached because of change into short glove exposure
- 12% decrease can be achieved because nurses can use a handalcohol instead of water and soap for hand disinfection after the patient related wet activity.

With these additional measures therefore a 24% decrease in exposure to water and detergents will be reached at the expense of increasing exposure to handalcohols and short time occlusion by gloves^(18;19).

Aim of this study

With this study we wanted to find out whether the above mentioned 2 additional preventive measures would lead to less skin irritation.

Materials and Method

On the basis of our observation studies⁽¹⁸⁾ the mean frequency and duration of wet work activities is known: on a regular ward a mean of 4 times per morning shift gloves are worn, hands are washed 10 times and 4 times hands become wet because of the activity patient washing. During a morning shift approximately 18 times the hands need to be disinfected with a handalcohol. The mean duration of skin irritation while doing one of these wet work activities is

1.4 minute for hand washing, 3,8 minutes for patient washing and 3.1 minute for wearing gloves.

All the observations were done during morning shifts, since nurses considered this the wettest shift themselves. For the observations occupational skin exposure to irritants in nursing activities were divided into a) exposure of the skin to water and soap; b) exposure to disinfectants: hand alcohol and c) exposure of the skin to occlusion by gloves. Nursing activities with possible skin exposure to irritants, excluding glove activities, were divided into patient washing; hand washing; other than patient washing; patient-related wet work and non-patient related wet work: e.g. housekeeping activities. Our observation method was unable to differentiate between the different reasons for the use of gloves - our observers were instructed not to ask nurses why a particular activity was carried out using gloves, as it was essential that the observations did not interfere with the activities.

According to these observation we modelled the mean daily wet work exposure during nursing work on a regular wards as follows:

Glove use:	4x 3 minutes
Hand washing	10 x 1-minute water & soap 18x handalcohol
Wet work activity	4x 4 minutes water & detergent

Implementation of the additional prevention measures could be modelled as follows:

Glove use:	6x 1 minute 4x 3 minutes 4x 4 minutes
Hand washing	2x 1 minute water & soap 30x handalcohol

To investigate the affect of our prevention measures, we enrolled 39 healthy volunteers, not having a wet work occupation or a wet work hobby, without signs of an atopic constitution and no signs of hand dermatitis. They were asked to expose their hands during 3 weeks, 5 days a week to one of these exposure models. The volunteers were at random allocated to either exposure model. Gloves in both models were used at one hand only. The hand that had to be covered with the glove was randomly chosen between the dominant and non-dominant hand.

All volunteers were individually instructed in hand washing, hand disinfection and glove use. In addition to this oral explanation they received a manual with all the instructions. Participants were included into to the study by a physician based on the outcome of a questionnaire, an additional interview and a physical examination on signs for atopic and/or skin disease. All participants gave written informed consent.

The participants used a diary to report when and how they applied their exposure model and to report all other daily exposures of their hands during 3 weeks, 7 days a week.

Both groups used vinyl occlusive gloves. Wet work cleaning activity in nursing was simulated with commercially available wet cleaning towels: Glorix[®], no bleach, no citronella: ingredients: 1-10% anionogenic surface active and 1-10% non-ionogenic surface active substances, 1-10% acids and salts pH stabilisers, 0.1-2% fragrances, 0-2% conservatives.

Hand disinfection was done with a commercially available handalcohol: Sterillium[®], ingredients: 45% isopropanol, 30% n-propanol, 0.2% macetronium ethylsulfate, myristyl alcohol, glycerine and fragrance). Hand washing proceedings were done with water and a commercially available and in hospitals widely used cationic pH neutral soap (Neutro Roberts disinfectant[®]).

Measurement of irritation with TEWL

Transepidermal water loss (TEWL) is the passive diffusion of water through stratum corneum, and is an indicator of the barrier function of the skin⁽¹¹⁾.

At day 0, day 7, day 14 and day 21, measurements were taken from the back of the hand with a TEWA-meter TW 210 (Courage & Khazaka, Cologne) according to the guidelines by the European Society of Contact Dermatitis⁽²¹⁾.

For acclimatisation all participants rested for 15 minutes before the TEWL measurements.

The volunteers had to finish all wet skin exposures at least 1 hour prior to the measurements and were not allowed to use moisturisers on their hands on the days of measurements. They also reported any use of moisturisers on other days in the diary.

The results are given in gm-2h-1. At each measurement site the TEWL was measured every 2 seconds, and when the standard deviation of a series of 15 measurements was less than 1 gm-2h-1, the mean value of these 15 measurements was recorded as TEWL value for this site.

Statistics

Statistical evaluation we used the software package SPSS 10.0. Parametric tests were used for comparison of the 2 groups before and after 3 weeks exposure to wet work simulations according to the described models: independent sample T-test. To compare the difference in TEWL after 3 weeks exposure within each model between glove hand and contralateral non-glove hands the paired-samples test was used. A significance level of 5% was chosen.

For detecting a smallest clinically relevant difference of 4 g/m²h in TEWL value with a power of 80% or higher a sample size of 16 would be needed.

Results

In this study 39 volunteers were enrolled, 2 participants: one in each group, dropped out after the first week of exposure, because of erythema as possible early sign of dermatitis. In both groups data of 2 participants were excluded

because the exposure recording in their diary was insufficient (Table 1). Data of 33 volunteers could be analysed: 17 in the regular model and 16 in the prevention model.

	Regular model	Prevention model
Number (gender)	17(1 male, 16 female)	16(3 male, 13 female)
Drop out	1 (female)	1 (female)
Exclusion	2 (female)	2 (1 male, 1 female)
Additional wet exposures (SD)	4.09 per day (1.9)	3.76 per day (2.4)
Base line TEWL (SD)	19.3 gm-2h-1(8.8 gm-2h-1)	16.6 gm-2h-1(8.5 gm-2h-1)

Table 1: Characteristics of participants

Measurements of transepidermal water loss

Difference in TEWL change after 3 weeks exposure simulation are shown in fig 1. With both parametric and non-parametric tests a statistically significant difference in TEWL change was found between the regular exposure model and the prevention exposure model. After 3 weeks of exposure simulation the regular exposure model showed a mean increase in TEWL of 9.6 gm-2h-1 and the prevention exposure model a decrease in TEWL of 2.1 gm-2h-1, parametric test, independent-samples t-test: confidence interval 2.7-20.8, p= 0.013.

In both exposure groups no significance difference in TEWL change between gloved hands and bare hands was found: figure 2. The mean change in TEWL in the regular model was 9.6 gm-2h-1 increase for the glove hands and 3.6 gm-2h-1 increase for the bare hands.

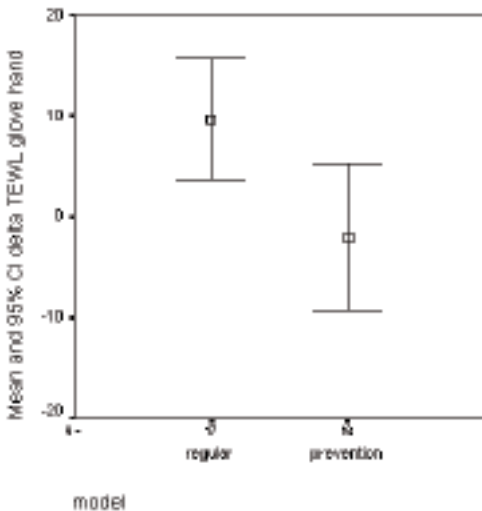


Fig. 1: TEWL change of the back of the hands: regular exposure model versus prevention model.

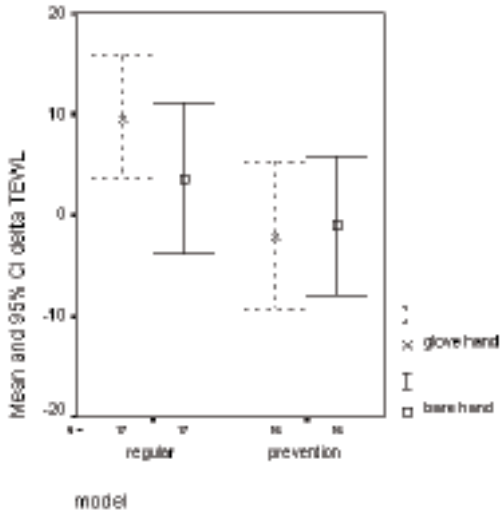


Fig. 2: Difference in change in TEWL between gloved and bare hands in two different (regular versus prevention) exposure models.

In the prevention model the mean change in TEWL was 2.1 gm-2h-1 decrease for the gloved hands and 1.0 gm-2h-1 decrease for the bare hands. The difference in change in TEWL between the glove hand and bare hand in the regular exposure group in this study tends to be larger on the glove hands compared to the bare hands: paired-samples t-test: $p = 0.093$.

Discussion

In this study we investigated the change in irritant effect on the skin by modelling 2 additional skin protection measures in nursing. These protection measures are part of a prevention program against occupational dermatitis and include: using gloves in all wet work activities and use water and soap only when hands are visible dirty (Table 2). We designed this study for investigating the effect on TEWL with these two models as an alternative for a study design with nurses performing actual nursing activities before and after having an educational intervention. Such a design with 'live' nurses doing their nursing activities on a ward would be influenced by:

- the success of the education program on the preventive measures
- the differences in daily occupational wet work exposure on the wards
- difficulties in obtaining reliable retrospective self-reporting of exposures to skin irritants
- effect on the skin because of pre-study exposure to skin irritating wet nursing activities

Our study design, which is based on real time observations, ensures the same exposures during the study period, and enrolled participants without skin irritating activities prior to the study.

This study focussed on the effectiveness of 2 additional preventive measures that would lead to a situation where the same nursing activities can be performed in a less skin irritating way. Our prevention model implies that patient washing and other wet work activities are done with gloves and that for hand disinfectant procedures, in situations that the hands are not visible dirty, a handalcohol is used. Theoretically this would lead to a 24% decrease in exposure to water and soap, at the expense of an increase in exposure to handalcohol and occlusion.

We found an increase in skin irritations after a 3-week exposure to our modelled regular nursing activities, whereas after a 3-week exposure to our prevention model a decrease in skin irritations was seen.

In the prevention model we did not observe an increase in skin irritation on the gloved hand compared to the contralateral bare hand. However, after being exposed to our regular exposure model a tendency of increased irritation from occlusion by gloves was seen. This might be the result of the combination of occlusion with water and soap exposure. Remains of the detergent on the skin may cause the additional irritation when gloves are used. In the preventive model the exposure to soap is very low. The increased occlusive exposure: gloves, which is part of the prevention model, may have no additional irritating effect because of the almost elimination of soap exposure. The differences in cumulative irritating skin effects between repeated exposure to water and soap and repeated exposure to a handalcohol, in combination with short-term occlusive glove exposure, needs further investigation.

The results of this study in combination with the results of studies comparing the disinfectant capacity of handalcohol with to water & soap^(15;17;22;23) justify the conclusion that in nursing-work handalcohol is the preferred disinfectant.

In addition to prevention measures the following recommendations can be derived from the results of this study:

- 1 use of a handalcohol in stead of water and soap in disinfection procedures, when the hands are not visibly dirty
- 2 use of gloves in wet activities such as patient washing, to prevents become wet and visibly dirty

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