Contact Dermatitis 2006: 55: 291–294
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CONTACT DERMATITIS

Adverse skin reactions to personal protective equipment against severe acute respiratory syndrome – a descriptive study in Singapore

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Severe acute respiratory syndrome (SARS) was first recognized in February 2003. It is the first severe and readily transmissible new disease to emerge in the 21st century. Healthcare workers in affected countries were exposed to the regular use of personal protective equipment (PPE) such as the N95 mask, gloves, and gowns. Our aim was to study the prevalence of adverse skin reactions to PPE among healthcare workers in Singapore during the SARS outbreak. Healthcare staff in the National Skin Centre and Tan Tock Seng Hospital were surveyed using questionnaires. Of those asked to participate, 322 (94.7%) agreed. 14.3% of the respondents were doctors, 73.0% nurses, and 12.7% other ancillary staff. Mean age of respondents was 32.4 years, with the majority being women (85.7%) and Chinese (53.7%). 109 (35.5%) of the 307 staff who used masks regularly reported acne (59.6%), facial itch (51.4%), and rash (35.8%) from N95 mask use. 64 (21.4%) of the 299 who used gloves regularly reported dry skin (73.4%), itch (56.3%), and rash (37.5%). The use of PPE is associated with high rates of adverse skin reactions. There is a need to find suitable alternatives for affected staff and to encourage awareness among staff of the role of dermatologists in their care.

Key words: healthcare workers; N95 mask; occupational; PPE; SARS. © Blackwell Munksgaard, 2006.

Accepted for publication 9 July 2006

Severe acute respiratory syndrome (SARS) was first officially reported in Asia in February 2003 (1). According to the World Health Organization (WHO), a total of 8098 people worldwide were affected by SARS during the 2003 outbreak. Of those infected, 774 died (2). The outbreak in Singapore began in March 2003. Over the subsequent 3 months, there were 33 deaths from the 476 affected (3). On 4 May 2003, the Centres for Disease Control (CDC) advisory against travel to Singapore was lifted. Currently, there is no known SARS transmission anywhere in the world. The most recent human cases of SARS infection were reported in China in April 2004, in an outbreak resulting from laboratory-acquired infections. However, there remains continued vigilance against a similar outbreak of this virus for which there is as yet no cure or vaccine available.

Healthcare workers who cared for afflicted patients in affected countries were at great risk of contracting the disease and therefore a protective gear was worn. Personal protective equipment (PPE) such as the N95 mask, gloves, and gowns would be worn often for hours at a time. Dermatologists at our centre had seen isolated cases of adverse skin reactions related to the use of PPE by healthcare staff. Many more may have had skin reactions but had self-medicated and did not involve the healthcare system, unless the reaction was especially severe. Based on this assumption, we suspected that adverse skin reactions to PPE occurred more frequently than expected.

Our aim was to determine the prevalence of adverse skin reactions to PPE among healthcare workers in Singapore and to characterize them, hence determining whether prolonged PPE use poses a significant occupational health risk.

Materials and Methods

On 22 March 2003, the Singapore government made a decision to centralize the care of suspected cases of SARS in Tan Tock Seng Hospital (TTSH) in an attempt to reduce the risk of secondary transmission of the disease. TTSH was officially declared as the 'SARS-designated hospital'. Hence, healthcare staff in TTSH continued the

use of PPE throughout till the alert status was downgraded in the middle of 2004.

The target population chosen for this study was healthcare staff in the National Skin Centre (NSC) and the Departments of Emergency (A&E) and Intensive Care (ICU) in TTSH. Questionnaires were used pertaining to the duration of the use of masks, gloves, and gowns, and adverse skin reactions arising from their use. Staff who had direct contact with patients were surveyed, and they included doctors, nurses, healthcare assistants, clerks, clinic assistants, and phlebotomists. Healthcare staff in NSC participated in a pilot survey in September 2003, and staff in TTSH were surveyed in April 2004.

Statistical analysis was performed using SPSS. Comparisons of differences between the groups were done using chi-square and 2-sample *t*-tests. A P value of less than 0.05 was considered significant.

Results

A total of 340 healthcare staff were surveyed. Of them, 322 (94.7%) responded. There were 60 respondents from NSC, 77 from TTSH A&E, and 185 from TTSH ICU, which is the largest among the 3 departments. 14.3% of respondents were doctors, 73.0% nurses, and 12.7% comprised other ancillary staff, which included counter-clerks and clinic assistants. The mean age of the respondents was 32.4 years, range 20–63 years. The majority were women, comprising 85.7% (276), while men comprised 14.3% (46). 53.7% were Chinese, 15.2% Filipino, 14.6% Indian, and 12.7% Malay, while 3.7% comprised other races such as Sikhs, Javanese, and Sinhalese.

Masks

109 (35.5%) of the 307 staff who used masks regularly reported adverse skin reactions, which included acne (59.6%), facial itch (51.4%), and rash (35.8%). All those who had skin reactions developed them while using N95 masks for an average duration of 8 hr a day and over a mean period of 8.4 months. Staff who only used surgical masks or paper masks did not report any skin reactions. Table 1 lists all the reported adverse reactions from the staff surveyed. 8 individuals reported pigmentation with mask use, with sites reported encompassing the nosebridge, cheeks, and chin. 94 of the 109 staff continued using N95 masks in spite of symptoms, while 10 staff switched to surgical masks instead. Only 15 of 109 staff sought treatment from a doctor, while the majority self-medicated or took no action.

Table 1. Clinical symptoms following prolonged N95 mask, glove, and gown use

Type of personal protective equipment	Symptom	Number of persons with symptom (%)
N95 mask[a]	Acne	65 (59.6)
	Itch	56 (51.4)
	Rash	39 (35.8)
	Pigmentation	8 (7.3)
	Scar at nosebridge	4 (3.7)
	Dry skin	2 (1.8)
	Wheals	1 (0.9)
	Increased pore size	1 (0.9)
	Peeling skin	1 (0.9)
	Runny nose	1 (0.9)
	Redness nosebridge	1 (0.9)
	Worsened asthma	1 (0.9)
Gloves[b]	Dry skin	47 (73.4)
	Itch	36 (56.3)
	Rash	24 (37.5)
	Wheals	4 (6.3)
Gown[c]	Itch	4 (100)
	Rash	3 (75)

[a]Number of patients with adverse reaction to masks = 109.
[b]Number of patients with adverse reaction to gloves = 64.
[c]Number of patients with adverse reaction to gowns = 4.

There were no significant differences in adverse skin reactions due to sex, race, or profession. However, staff who reported development of acne were younger (mean of 29.5 years) compared with staff who did not (mean of 33.2 years; $P < 0.001$), while development of facial itch and rash was not related to age.

Gloves

64 (21.4%) of the 299 staff who used gloves regularly reported adverse skin reactions, which included dry skin (73.4%), itch (56.3%), rash (37.5%), and wheals (6.3%) (Table 1). All were using rubber gloves for an average duration of 6.2 hr over a mean period of 9.4 months. None reported skin reactions with the use of plastic gloves. The majority continued using the rubber gloves, with only 8 discontinuing their use. Of the 8, 2 changed to a latex-free alternative, 2 substituted with plastic gloves, 2 wore plastic gloves underneath latex gloves, and 2 changed to nonpowdered latex gloves. 9 of the 64 staff sought treatment from a doctor, 19 self-medicated, and the others took no action. There were no significant differences in adverse skin reactions due to sex, race, or profession. However, staff who reported dry skin were younger (mean of 28.7 years) compared with staff who did not (mean of 33.2 years; $P = 0.002$), and staff who reported itch were again younger (mean of 28.7 years) compared with staff who did not (mean 33.0 years; $P = 0.005$).

Gowns

Only 4 (1.6%) of the 258 staff who wore gowns regularly reported adverse skin reactions. 3 individuals reported itch and rash on the wrist. 1 individual complained of itch only (Table 1). The gowns used were of the disposable variety and were worn for an average duration of 6.2 hr over a mean period of 8.8 months.

Discussion

N95 masks were recommended by the CDC and WHO for healthcare workers caring for suspected or confirmed SARS patients. These are generally used to protect against highly transmissible respiratory infections such as tuberculosis. 'N' stands for NIOSH – the National Institute for Occupational Safety and Health of the USA, and '95' indicates its filter efficiency. Hence, the mask is 95% efficient at filtering out particles of size 300 nm and above. The SARS coronavirus is 100 nm in size, but when expelled from patients, is usually larger because it is enveloped in saliva as droplets. The masks are made of polypropylene fabric, using a nonwoven technology that increases the density and filtering function (4). The most common adverse reaction reported to the N95 mask was acne, and this has 2 plausible explanations. First, a hot and humid microclimate is created in regions of the face covered by the mask, which predisposes to a flare-up of acne. Secondly, occlusion of pilosebaceous ducts due to local pressure on the skin from the close-fitting mask could result in a flare-up of acne (5). Itch and rash were reported frequently as well with most cases probably due to irritant contact dermatitis from components of the mask. True allergic contact dermatitis may occur to adhesives used in the masks or to mask components such as rubber straps or metal clips. Patch testing would be necessary to determine the true incidence of such cases. As for the 8 cases who reported pigmentation with mask use, a possible cause is postinflammatory hyperpigmentation or perhaps even pigmented contact dermatitis. A few patients also suffered from pressure-related effects of mask use, as illustrated by answers such as 'scar at nosebridge' and 'redness of nosebridge' in the questionnaires.

Skin reactions to gloves included complaints of dry skin, itch, and rash. Type I immunoglobulin E-mediated natural rubber latex hypersensitivity is an important, often undiagnosed, occupational health hazard for healthcare workers, especially in those with high exposure. Rates of sensitization ranging from 3% to 17% have been reported in the west. The most common clinical manifestations include contact urticaria, presenting with pruritus, erythema and/or wheals, eczematous lesions, rhinitis, and occupational asthma. In a recent study conducted in Singapore, a prevalence rate of latex sensitization of 9.6% was reported among healthcare workers (6). Latex sensitization could explain the symptoms reported by some individuals in our study, while a more likely explanation could be the increased frequency of hand-washing and exposure to soaps by healthcare staff, resulting in an irritant contact dermatitis of the hands. As would be expected, few respondents reported adverse skin reactions with the use of gowns.

Our study provides evidence of a high frequency of adverse skin reactions, with prolonged use of PPE, the N95 mask and rubber gloves in particular. To the best of our knowledge, this has not been described elsewhere in the dermatological literature. It is important to note, however, that the reported skin reactions could not be verified and documented by investigators, but were purely based on the subjective assessment of the healthcare staff themselves. In addition, we were unable to determine the severity of the skin reactions through the self-administered questionnaires although it would be reasonable to conclude that most reactions were of mild to moderate severity as most staff continued to use the equipment and few sought formal treatment with a physician. This study nonetheless provides an insight into the frequency of dermatological problems, which could arise from prolonged use of PPE. No doubt that the threat of SARS is presently contained in the world, but no one can say what other new contagion may emerge and thus such information may prove useful to the dermatological community in the future.

Acknowledgements

The authors thank all the healthcare staff who gave their time and effort in participating in this study. We also acknowledge Dr Yan XY from the Clinical Trials & Epidemiology Research Unit, Singapore, for her statistical input.

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