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# Occupational contact dermatitis among healthcare workers in the COVID-19 Isolation ward

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**Abstract**--Occupational skin disease due to intensified infection prevention procedures among healthcare workers has been reported since the outbreak of coronavirus disease-2019 (COVID-19). This study was to determine the cause of Occupational Contact Dermatitis (OCD) among healthcare workers in the COVID-19 isolation ward using a skin patch test to prevent the recurrence of the disease. The allergens for the patch test included thiuram-mix 1%, 2-

mercaptobenzothiazole 2%, and tetramethyl thiuram disulfide 1% which were contained in gloves, cobalt chloride 1%, and colophony 20% which were contained in adhesives, as well as irigasan 2% and lanolin 100% which were contained in hand hygiene products. Thirty healthcare workers who were diagnosed with OCD were included and underwent patch tests. The participants were dominated by females (90%) and nurses (66.67%). Six participants got weak positive (+) results from thiuram-mix 1%. Meanwhile 1 weak positive (+), 6 strong positive (++) and 1 extreme positive (+++) were found in lanolin 100% patch test. There was clinical relevance to these results. The infection prevention measures among healthcare workers in the COVID-19 isolation ward increased the risk of OCD, including the use of PPE and hand hygiene products.

**Keywords**---Hand hygiene, Human and Disease, Occupational dermatitis, Patch test, Personal protective equipment.

## **Introduction**

Occupational skin disease is a skin disease related to exposure to an occupational hazard. The most common occupational skin disease is occupational contact dermatitis (OCD) which includes irritant contact dermatitis, allergic contact dermatitis, contact urticaria, and protein contact dermatitis. Skin barrier dysfunction is one of the most prominent contributing factors. The skin acts as a primary line of defense against environmental hazards, providing physical, chemical, and biological protection. Atopic dermatitis (AD), ichthyosis, and contact dermatitis are all skin conditions in which the skin barrier is disrupted. External factors, such as skin irritants, interfere with the structure and composition of the stratum corneum. Genetic factors, such as filaggrin gene (FLG) mutations, may cause anomalies in skin barrier function and greater sensitivity to skin disorders. The cornified envelope protein filaggrin, which is important in skin barrier function, is encoded by FLG. The FLG mutation has been linked to the onset of OCD. Healthcare workers, hairdressers, and construction workers are among the high-risk jobs for OCD (John et al., 2020; Kasemsarn et al., 2016).

Occupational skin disease due to intensified infection prevention procedures among healthcare workers has been reported often since the outbreak of coronavirus disease-2019 (COVID-19) in December 2019. Direct skin damage and worsening of pre-existing dermatoses, such as contact dermatitis, seborrheic dermatitis, and acne, have been documented often among health care workers as a result of prolonged use of personal protective equipment (PPE) (Choi et al., 2021). Healthcare workers in the COVID-19 isolation ward were required to follow the infection prevention procedures such as hand hygiene, use of surgical mask or N95 mask, goggles, face shield, coverall gown, safety shoes, and shoe covers. Hand hygiene can be performed in one of two ways: by washing hands with soap and water or by using a hand sanitizer with at least 60% alcohol (Damayanti et al., 2021; Lan et al., 2020). A survey in China reported that 97.0% (526 of 542) of first-line healthcare workers had skin damage as a result of the infection prevention procedures, with the nasal bridge being the most affected site (83.1%),

followed by cheeks (78.7%), hands (74.5%), and forehead (57.2%) (Damayanti et al., 2021).

An epidemiological study of healthcare workers in Indonesia found that at least 66.5% of respondents (113 of 200) reported adverse skin reactions after the use of PPE. The most common skin complaints were dryness/tightness of the skin (63.9%) and itchy skin (59.4%), while the most complained sites were cheek and chin (69.9%) followed by forehead (42.9%), fingers/interdigital (38.3%), and palms (35.3%) (Christopher et al., 2020). Facial skin disease and hand dermatitis are the most prevalent occupational skin disease found among healthcare workers during the COVID-19 pandemic. The facial skin disease includes contact dermatitis, acne, rosacea, and worsening of previous facial skin, disease (Choi et al., 2021). Hand dermatitis among healthcare workers during the COVID-19 pandemic had a 29% of 1-year prevalence according to a study. It was found that hand dermatitis had a significant correlation to the frequency of hand washing with soap and the duration of wearing gloves at work (Hamnerius et al., 2021).

To determine the diagnosis of OCD, a history of work-related exposure must be assessed thoroughly (John et al., 2020). The Mathias criteria are commonly used to determine the possible occupational causes of contact dermatitis. Four out of seven criteria must be met to determine the causal link between contact dermatitis and workplace hazard. The diagnosis of OCD can be established by assessing the Mathias criteria, patient's clinical history, and skin patch test (Gomez de Carvallo et al., 2012). It is hard to tell the difference between irritant and allergic contact dermatitis, especially in the chronic stage. It's not uncommon for the two disorders to coexist. If patch tests are negative, while there is an irritant exposure and the condition develops and cures depending on the frequency and intensity of the exposure, irritant dermatitis might be diagnosed (John et al., 2020). This study was to determine the cause of occupational contact dermatitis among healthcare workers in the COVID-19 isolation ward with a skin patch test.

## **Method**

Healthcare professionals working in the COVID-19 isolation ward of Dr. Soetomo General Academic Hospital, Surabaya, Indonesia underwent patch tests as a part of this cross-sectional study. Purposive sampling was used to determine the sample. The inclusion criteria for this study were positive history of wearing personal protective equipment (PPE) and washing hands/disinfecting during the last 2 months, positive history or currently experiencing skin complaints related to work, had met the Mathias criteria for occupational contact dermatitis, and willing to take part in the study. The types of PPE assessed in the study were surgical mask, N95 mask, face shield, goggles, gown, apron, gloves, hair cap, and oppo tape.

Allergens used for patch tests were produced by the Faculty of Medicine Universitas Gadjah Mada, Yogyakarta, Indonesia. The allergens included thiuram-mix 1%, 2-mercaptobenzothiazole 2%, and tetramethyl thiuram disulfide 1% which were contained in gloves, cobalt chloride 1%, and colophony 20% which were contained in adhesives such as oppo tape, as well as substances commonly

found in hand sanitizer including irigasan 2% and lanolin 100%. The open test was carried out using small pieces of PPE materials which many respondents complained about such as gloves, hand sanitizer, oppo tape, N95 masks, and goggles on the inside of the elbow. The grading of the International Contact Dermatitis Research Group (ICDRG) was used to interpret the patch test results. According to the ICDRG, patch test results can be graded as (-) negative; (-+) doubtful reaction with faint erythema only; (+) weak positive reaction with non-vesicular erythema, infiltration, possibly papules; (++) strong positive reaction with vesicular erythema, infiltration, and papules; (+++) extreme positive reaction with intense erythema and infiltration, merged vesicles, and bullous (Fonacier, 2015). The results were recorded and analyzed with descriptive analysis. This study received ethical clearance from the Ethical Committee of Dr. Soetomo General Academic Hospital Surabaya, Indonesia (No. 0160/KEPK/III/2021).

## Results

This study involved 30 healthcare workers who were previously had been diagnosed with occupational contact dermatitis. Table 1 shows the characteristic of the participants. The mean age of the participants was  $33.13 \pm 6.56$  with 30-34 years old as the most prevalent age group (43.33%). The participants were dominated by females (90%) and nurses (66.67%).

Table 1. Subject characteristics

Characteristics	Total (%)
Gender	
Female	27 (90)
Male	3 (10)
Age Group (years old)	
$\leq 24$	2 (6.67)
25-29	5 (16.67)
30-34	13 (43.33)
35-39	6 (20)
40-44	2 (6.67)
45-49	0 (0)
$\geq 50$	2 (6.67)
Profession	
Resident doctor	2 (6.67)
Nurse	20 (66.67)
Midwife	8 (26.67)

The patch test was done with the available reagents including those of substances commonly contained in gloves, oppo tape/adhesives, and hand hygiene products. Six participants got weak positive (+) results from 1 out of the 3 suspected allergens contained in gloves which was thiuram-mix 1%. The patch test for allergens in oppo tape showed no positive result, while 1 weak positive (+), 6 strong positive (++) , and 1 extreme positive (+++) were found in the lanolin 100% patch test, an allergen commonly found in hand hygiene products (table 2). Furthermore, an open test was carried out using "as is" material, namely a sample of small pieces of the suspected PPE material, which many respondents complained about, such as gloves, hand sanitizer, oppo tape, N95 masks, and

goggles on the inside of the elbow. All participants in this study showed no manifestation of redness or urticaria after being exposed to PPE materials in the open test.

Table 2. Patch test results

Allergen	(-)	(-/ +)	(+)	(++)	(+++)	Total (%)
Thiuram-mix 1%	0	0	6	0	0	6 (20)
2-mercaptobenzothiazole 2%	0	0	0	0	0	0 (0)
Tetramethylthiuram disulfide 1%	0	0	0	0	0	0 (0)
Cobalt Chloride 1%	0	0	0	0	0	0 (0)
Colophony 20%	0	0	0	0	0	0 (0)
Irigasan 2%	0	0	0	0	0	0 (0)
Lanolin 100%	0	0	1	6	1	8 (26.67)

The clinical relevance of allergy test findings should be taken into account to be able to make a decision that is beneficial to the patient. The patient's clinical history and patch test results of Thiuram-mix 1% and Lanolin 100% were assessed for the clinical relevance of the test (table 3). Six out of ten participants (60%) with a history of skin complaints after the use of gloves showed positive results with Thiuram-mix 1%. Meanwhile, all 8 participants (100%) that had complained of skin problems after the use of hand hygiene products got positive results for Lanolin 100%.

Table 3. Clinical relevance of patch test results

		Patch test result	
		Positive	Negative
Skin complaints after exposure to gloves (Thiuram-mix 1%)	Yes	6	4
	No	0	20
Skin complaints after exposure to hand hygiene products (Lanolin 100%)	Yes	8	0
	No	0	22

## Discussion

Indonesia is one of the countries affected by the COVID-19 pandemic. The World Health Organization (WHO) had advised the community, particularly healthcare workers, to use PPE to reduce the risk of catching the virus. The prolonged use of PPE and frequent hand hygiene can cause adverse skin reactions among healthcare workers (Christopher et al., 2020). The most common occupational skin diseases found among healthcare workers during the pandemic are facial skin disease and hand dermatitis. Irritant or allergic contact dermatitis, as well as endogenous causes such as atopic dermatitis, can induce hand dermatitis. Hand hygiene products cause denaturation of stratum corneum proteins, alterations in intercellular lipids, reduced corneocyte cohesiveness, and decreased stratum corneum water-binding capacity, all of which damage the skin barrier (Christopher et al., 2020; Sudan & Pittet, 2009).

In order to diagnose contact dermatitis, a patient's medical history, a physical examination, and skin testing in the form of a patch test are required (Wilkinson & Orton, 2017). The basis of the patch test is the attachment of the test material

(with a preset concentration and solvent) to normal skin. The patch test is performed using both open and closed testing methodologies. The open test is conducted with "as is" material, a small sample of the suspect substance and is performed if there is a patch test result with a faint or weak positive or to determine whether the patch test result is clinically relevant. In this study, the open test was carried out using "as is" materials, namely small pieces of PPE materials, which respondents complained about, such as gloves, hand sanitizers, oppo tape, N95 masks, and goggles. Positive results are expected to appear reddish or urticaria on the skin. The principle is to apply the test material 1-2 times/day, let it sit for a few minutes, then rinse it off and do it for 1 week on an area of 5x5 cm<sup>2</sup> of skin on the inside of the elbow. Observations were made after the first 20 minutes and after the first 24 hours, the open test was repeated for 1 week.

Several factors can affect the results of the open test, including patch test sensitivity, dose and exposure time, cutaneous penetration, and other undetermined factors. As highlighted by Farm et al, in their research on colophony, concluded that with a higher sensitivity of the patch test, more patients will have positive open test results (Farm, 1998). Low concentrations or short exposure time can cause a minimal visible reaction with a few papules without erythema, on the contrary, higher concentrations or longer exposure time causes clearly visible papules with well-defined erythema (Diepgen et al., 2016). The open test in this study had a short exposure time, so according to the statement from the research in this study, skin damage occurred due to long exposure to health workers in isolation rooms when using PPE and hand sanitizer activities, which was for 3-6 hours while on duty.

Anatomical differences in the area of exposure affect skin reactivity, although no direct relationship was found between skin permeability, skin thickness, and skin irritation. The physical and chemical content of the topical vehicle, the composition of the stratum corneum, and several processes determine cutaneous metabolism in the absorption of chemicals (allergens) through the skin (Noviandini & Prakoeswa, 2014). Nevertheless, other factors that have not been determined include the nature of the related allergen, the concentration of the serial dilution, the vehicle used, the permeability, and the occlusion effect of the product, which can affect the reactivity of the open test (Farm, 1998; Nakada et al., 2000).

The reading of the patch test results is not only a positive or negative score. It is meaningless if it is not related to the patient's clinical and medical history, in other words, a positive patch test is not important if it is not noted to be relevant or not (Lachapelle et al., 2012). Relevance of the test can be determined if the patch test is positive for one or more allergens and the causative allergen corresponds to the occurrence of an allergic reaction if the product is used on certain skin areas of the body and causes eczema. The clinical relevance of allergic reactions in patch testing is established based on clinical history, type of dermatitis, and relevant allergen (Noviandini & Prakoeswa, 2014).

Gloves are a well-known cause of occupational hand allergic contact dermatitis among healthcare workers. Rubber accelerator compounds such as thiurams,

carbamates, benzothiazoles, guanidines, and thioureas have been noted as major glove-related allergies. Natural rubber latex and nonlatex (e.g., nitrile) gloves both include rubber accelerators, whereas vinyl gloves do not. According to a study from 1998 to 2004, the most prevalent relevant allergens of healthcare workers that underwent patch testing were thiuram-mix and carba-mix, which were found in 8.87% and 5.43% of, respectively (Lee et al., 2021). In this study thiuram-mix 1% allergy was found in 20% of the participants, presenting as weak positive results on the patch test. It was also shown that among 10 healthcare workers who had complained of skin problems after the use of gloves, 6 of them received positive results on the patch test of thiuram-mix 1% which made the test clinically relevant.

Hand hygiene products may include a wide range of allergies. According to recent studies, benzalkonium chloride sensitization is increasing. Other common allergens based on epidemiological studies are fragrance, sodium benzoate, and propylene glycol (Lee et al., 2021). Lanolin is commonly used as a skin moisturizer and is also contained in several skincare and beauty products, such as soap and lipstick. The use of lanolin can have side effects, namely burning or stinging of the skin, reddened skin, peeling skin, and skin irritation that gets worse (Fransen et al., 2018). This study found that 100% Lanolin might trigger dermatitis symptoms in patients with a total of 8 positive results (26.67%) including 6 erythema, infiltration, papules, vesicles classified as strong positive, 1 classified as weak positive, and 1 classified as extreme positive result. Many studies suggest the allergen is present in the alcoholic fraction, although oxidation, which results in the generation of potential haptens, has also been discovered to be relevant. The use of soap containing lanolin for hand washing can be expected to increase the risk of developing contact dermatitis (Uldahl et al., 2021). The limitation of this study was the availability of the allergen extract that can be used for patch tests. There is a possibility that other compounds found in gloves or hand hygiene products may cause dermatitis among healthcare workers.

The following measures can be taken to prevent OCD in healthcare workers and other occupations that generally use PPE on daily basis: Before using a mask, one should wash the face gently, especially on the forehead, bridge of the nose, cheeks, under the chin, and behind the earlobe. Apply a thin layer of noncomedogenic moisturizer all over the face. This item will serve as a barrier between the mask and the skin. Apply a face-specific antiperspirant if the skin is prone to excessive moisture or perspiration. In a matter of fact, there are possible allergic reactions to mask components. A strip of glue or rubber down the nose or a metal wire are the most prevalent allergies. Generally, wire is made of nickel, which is one of the allergen materials, hence it can be coated with hydrogel dressings, bandages, or foam material to prevent OCD (Kelechi et al., 2020). The use of moisturizer after washing hands is useful to cover the surface of the skin and prevent water loss. Occlusive, humectant, and emollient are the types of moisturizers to prevent OCD. The moisturizers must be immediately applied after washing hands and before wearing gloves (Damayanti et al., 2021; Rundle et al., 2020).

## Conclusion

The infection prevention measures among healthcare workers in the COVID-19 isolation ward increased the risk of OCD, including the use of PPE and hand hygiene products.

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## References

- Choi, S. Y., Hong, J. Y., Kim, H. J., Lee, G. Y., Cheong, S. H., Jung, H. J., Bang, C. H., Lee, D. H., Jue, M. S., Kim, H. O., Park, E. J., Ko, J. Y., Son, S. W. (2021). Mask-induced dermatoses during the COVID-19 pandemic: a questionnaire-based study in 12 Korean hospitals. *Clinical and Experimental Dermatology*, 46(8): 1504–1510.
- Christopher, P.M., Roren, R. S., Tania, C., Jayadi, N. N., Cucunawangsih, C. (2020). Adverse Skin Reactions to Personal Protective Equipment among Health-Care Workers during COVID-19 Pandemic: A Multicenter Cross-sectional Study in Indonesia. *International Journal of Dermatology and Venereology*, 3(4): 211–218.
- Damayanti, Prakoeswa, C. R. S., Anggraeni, S., Umborowati, M. A. (2021). Prevention of Contact Dermatitis Due to Hand Hygiene in The Era of COVID-19. *Berkala Ilmu Kesehatan Kulit dan Kelamin*, 33(3): 162–167.
- Diepgen, T. L., Ofenloch, R. F., Bruze, M., Bertuccio, P., Cazzaniga, S., Coenraads, P. J., Elsner, P., Goncalo, M., Svensson, A., Naldi, L. (2016). Prevalence of contact allergy in the general population in different European regions. *British Journal of Dermatology*, 174(2): 319–329.
- Farm G. (1998). Repeated Open Application Tests (ROAT) in Patients Allergic to Colophony-Evaluated Visually and with Bioengineering Techniques. *Acta Derm Venereol (Stockh)*, 78(2): 130–135.
- Fonacier, L. (2015). A Practical Guide to Patch Testing. *Journal of Allergy and Clinical Immunology: In Practice*, 3(5): 669–675.
- Fransen, M., Overgaard, L. E., Johansen, J. D., Thyssen, J. P. (2018). Contact allergy to lanolin: temporal changes in prevalence and association with atopic dermatitis. *Contact Dermatitis*, 78(1): 70–75.
- Gómez de Carvalho, M., Calvo, B., Benach, J., Pujol, R., Giménez-Arnau, A. M. (2012). Assessment of the Mathias Criteria for Establishing Occupational Causation of Contact Dermatitis. *Actas Dermosifiliogr*, 103(5): 411–421.
- Hamnerius, N., Pontén, A., Bergendorff, O., Bruze, M., Björk, J., Svedman, C. (2021). Skin exposures, hand eczema and facial skin disease in healthcare workers during the covid-19 pandemic: A cross-sectional study. *Acta Dermato-Venereologica*, 101(9).
- <https://doi.org/10.2340/00015555-3904>



- John, S. M., Johansen, J. D., Rustemeyer, T., Elsner, P., Maibach, H. I., editors. (2020). *Kanerva's Occupational Dermatology Third Edition*. Switzerland: Springer.
- Kasemsarn, P., Bosco, J., Nixon, R. L. (2016). The Role of the Skin Barrier in Occupational Skin Diseases. *Current Problems in Dermatology (Switzerland)*, 49: 135–143.  
<https://doi.org/10.1159/000441589>
- Kelechi, T. J., Brunette, G., Lee, L. W. (2020). Personal Protective Equipment-Related Equipment Dermatitis: A View from Here. *Journal of Wound Ostomy and Continence Nursing*, 47(4): 324–325.
- Lachapelle, J. M., Maibach, H. I., Ring, J., Darsow, U., Rustemeyer, T. (2012). *Patch testing and prick testing: a practical guide official publication of the ICDRG*. Heidelberg: Springer.
- Lan, J., Song, Z., Miao, X., Li, H., Li, Y., Dong, L., Yang, J., An, X., Zhang, Y., Yang, L., Zhou, N., Yang, L., Li, J., Cao, J., Wang, J., Tao, J. (2020). Skin damage among health care workers managing coronavirus disease-2019. *J Am Acad Dermatol*, 82(5): 1215–1216.
- Lee, E. B., Lobl, M., Ford, A., Deleo, V., Adler, B. L., Wysong, A. (2021). What Is New in Occupational Allergic Contact Dermatitis in the Year of the COVID Pandemic? *Current Allergy and Asthma Reports*, 21(4): 26.
- Nakada, T., Hostynek, J. J., Maibach, H. I. (2000). Use tests: ROAT (repeated open application test)/ PUT (provocative use test): an overview. *Contact Dermatitis*, 43(1): 1–3.
- Noviandini, A., Prakoeswa, C. R. S. (2014). Patch Test and Repeated Open Application Test (ROAT) in Allergic Contact Dermatitis. *Berkala Ilmu Kesehatan Kulit dan Kelamin*, 26(3): 220–228.
- Rundle, C. W., Presley, C. L., Militello, M., Barber, C., Powell, D. L., Jacob, S. E., Atwater, A. R., Watsky, K. L., Yu, J., Dunnick, C. A. (2020). Hand hygiene during COVID-19: Recommendations from the American Contact Dermatitis Society. *Journal of the American Academy of Dermatology*, 83(6): 1730–1737.
- Sudan, R., Pittet, D., editors. (2009). *WHO guidelines on hand hygiene in health care: first global patient safety challenge clean care is safer care*. Switzerland: WHO.
- Uldahl, A., Engfeldt, M., Svedman, C. (2021). Clinical relevance of positive patch test reactions to lanolin: A ROAT study. *Contact Dermatitis*, 84(1): 41–49.
- Wilkinson, M., Orton, D. (2017). Acrylate allergy: time to intervene. *Contact Dermatitis*, 77(6): 353–355.