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# PPE-Associated Skin Lesions Among ICU Healthcare Workers: Clinical Characteristics and Anatomical Distribution

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**Abstract:** Background: Personal protective equipment (PPE) is essential in intensive care units, especially when caring for patients with severe respiratory infections. At the same time, prolonged use of respirators, gloves, gowns, and face shields, together with frequent hand hygiene, can irritate the skin and weaken the skin barrier. These reactions may affect comfort during long shifts and make continued PPE use more difficult. Objective: This study evaluated the prevalence, clinical characteristics, morphology, symptoms, and anatomical distribution of PPE-associated skin lesions among ICU healthcare workers. Methods: This cross-sectional observational study included physicians and nurses working in respiratory infection ICUs of governmental hospitals affiliated with Isfahan University of Medical Sciences, Iran. Demographic and occupational data were collected using a structured questionnaire. All participants were examined by board-certified dermatologists, and lesion type, morphology, symptoms, and anatomical distribution were recorded. Results: Among 68 ICU healthcare workers, 61 participants (89.7%; 95% CI, 80.0–95.8) had at least one PPE-associated skin lesion. Clinically diagnosed contact dermatitis was the most frequent diagnosis (77.9%), followed by acne (10.3%) and eczema (7.4%). Erythema was the most frequent morphological finding (70.6%), pruritus was the most frequently reported symptom (88.2%), and the hands were the most commonly affected anatomical site (83.8%). Conclusion: PPE-associated skin lesions were common in this regional ICU cohort. Clinically diagnosed contact dermatitis, pruritus, erythema, and hand involvement were the predominant findings. Because the cross-sectional design does not establish causality, these findings should be interpreted as clinically probable occupational associations and require confirmation in larger longitudinal studies.

**Keywords:** occupational dermatoses; healthcare workers; personal protective equipment; intensive care unit; contact dermatitis; COVID-19; skin barrier; occupational health



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## 1. Introduction

Personal protective equipment (PPE) is central to the protection of healthcare workers caring for patients with transmissible respiratory infections. In intensive care units (ICUs), staff often wear respirators, gloves, gowns, goggles, and face shields for long periods because bedside care, airway procedures, and close patient contact are frequent. This protection, however, comes with a dermatologic cost. Prolonged PPE use can expose the skin to pressure, friction, occlusion, heat, sweating, and repeated contact with cleansing agents or disinfectants. Over time, these exposures may lead to PPE-associated dermatoses, particularly during long ICU shifts when opportunities to remove equipment or allow the skin to recover are limited [1–4].

The COVID-19 pandemic made these skin problems much more visible. Healthcare workers, especially those in respiratory and critical-care units, had to use masks, respirators, gloves, gowns, and eye protection for longer periods and often under considerable clinical pressure. Reports from this period described a wide range of PPE-associated skin reactions, including dryness, erythema, itching, contact dermatitis, acneiform eruptions, and pressure injury. Although many of these data came from the pandemic period, the issue has not disappeared. Respiratory infection ICUs still require sustained PPE use during outbreaks and during the care of patients with highly transmissible infections [5–8].

PPE-associated skin injury usually develops gradually, after repeated stress on the skin barrier. Frequent handwashing and alcohol-based disinfectants can remove surface lipids, increase transepidermal water loss, and weaken the stratum corneum. Prolonged glove use adds another layer of irritation by trapping heat and moisture against the skin. On the face, tight respirators, masks, and goggles create pressure and friction, especially over the nasal bridge, cheeks, and behind the ears. With continued exposure, early irritation may progress to erythema, itching, fissuring, acneiform eruptions, or clinically evident contact dermatitis. In some workers, allergens such as rubber accelerators, adhesives, preservatives, metals, or textile components may also trigger allergic contact dermatitis or worsen pre-existing inflammatory skin disease [7,9,10].

ICU healthcare workers are likely to be at higher risk because their PPE exposure is repeated and often prolonged. In respiratory infection ICUs, patient care may require long bedside contact, frequent hand hygiene, repeated glove changes, and continuous use of respirators or eye protection during high-risk procedures. Long shifts and limited opportunities for skin recovery can further increase this exposure. ICU-specific data support this concern; for example, hand dermatitis among ICU nurses has been reported with a 1-year prevalence of 26.6% and a point prevalence of 9.8%. These findings suggest that ICU work may create a different pattern of PPE-associated skin risk compared with less intensive clinical settings [10].

The importance of PPE-associated dermatoses is not limited to their visible appearance. Symptoms such as itching, burning, tenderness, or pain can make long shifts more uncomfortable and may reduce tolerance of gloves, masks, or respirators. Hand lesions can make repeated disinfection painful, while facial irritation may lead workers to adjust masks or goggles more often during patient care. These responses are usually driven by discomfort, but they matter in settings where continuous protection is required. For this reason, PPE-associated skin disease should be viewed not only as a dermatologic problem, but also as a practical occupational health issue for healthcare workers [5,11–13].

Although PPE-associated skin problems have been widely reported, important gaps remain. Many studies have included mixed groups of healthcare workers or have relied mainly on self-reported symptoms. Less is known about ICU staff specifically, and fewer reports have described lesions after direct dermatologic examination. Data from Middle Eastern ICU settings are also limited. This is relevant because climate, PPE availability, staffing patterns, and daily work routines may influence both the frequency and the clinical pattern of PPE-associated skin injury [5,14].

The present study was designed to evaluate the prevalence and clinical distribution of PPE-Associated Skin Lesions among physicians and nurses working in respiratory infection ICUs of governmental hospitals affiliated with Isfahan University of Medical Sciences in Isfahan, Iran. We used direct dermatologic examination to record lesion type, morphology, symptoms, and anatomical site, rather than relying only on self-reported complaints. By focusing on ICU healthcare workers in a Middle Eastern setting, this study adds setting-specific clinical data that may help guide practical skin-protection measures and earlier dermatologic support for frontline staff.

## 2. Materials and Methods

### 2.1. Study Design and Setting

This cross-sectional observational study was conducted from June to August 2021 in respiratory infection intensive care units (ICUs) of university-affiliated public hospitals in Isfahan, Iran. The participating hospitals were affiliated with Isfahan University of Medical Sciences. The study was designed to estimate the prevalence

and describe the clinical characteristics, morphology, symptoms, and anatomical distribution of skin lesions judged to be related to personal protective equipment use among ICU healthcare workers. This study is reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement for cross-sectional studies.

## 2.2. Participants and Eligibility Criteria

Physicians and nurses working in the participating respiratory infection ICUs during the study period were invited to participate. Eligible participants were healthcare workers who had been employed in the ICU for at least two months, routinely used PPE during patient care, provided written informed consent, and completed both the study questionnaire and dermatologic examination. Recruitment was based on the availability of eligible healthcare workers during the predefined study period. No formal a priori sample size calculation was performed. Healthcare workers who declined participation, withdrew consent, or had incomplete questionnaire data or incomplete dermatologic assessment were excluded from the analysis. The final sample consisted of 68 eligible participants with complete clinical and questionnaire data.

## 2.3. Data Collection

Demographic and occupational data were collected using a structured questionnaire. Recorded variables included age, sex, educational level, professional category, duration of ICU employment, daily working hours in the ICU, and PPE use during clinical duties. PPE-associated variables included the use of surgical masks, other non-medical face masks, N95 respirators, face shields, goggles, gloves, and gowns. Participants were also asked about dermatologic symptoms temporally associated with PPE use, including pruritus, burning sensation, discomfort, and absence of symptoms.

## 2.4. Definition of PPE-Associated Skin Lesions

For this study, PPE-associated skin lesions were defined as new-onset skin lesions that were considered clinically compatible with occupational PPE exposure. Classification was based on a comprehensive clinical assessment incorporating the participant's exposure history, the temporal relationship between symptom onset and PPE use, the anatomical distribution of lesions in areas exposed to PPE contact, pressure, friction, occlusion, or frequent hand hygiene, and the lesion morphology observed during dermatologic examination. Alternative dermatologic diagnoses unrelated to occupational exposure were considered, and lesions were not classified as PPE-associated when another diagnosis provided a more likely explanation. Because of the cross-sectional design and the absence of confirmatory investigations such as patch testing or skin biopsy, causality could not be established. Lesions were therefore classified as PPE-associated only when the overall clinical assessment supported a probable occupational association.

## 2.5. Clinical Dermatologic Assessment

All participants underwent standardized dermatologic examination by two board-certified dermatologists. Cases with diagnostic uncertainty or disagreement were reviewed with a third board-certified dermatologist, and a consensus diagnosis was reached. Formal interobserver agreement was not quantified.

Dermatologic diagnoses were established clinically based on lesion morphology, anatomical distribution, associated symptoms, exposure history, temporal relationship with PPE use, and the overall clinical pattern. Clinically diagnosed contact dermatitis was identified by an eczematous pattern involving erythema, pruritus, papules, vesicles, or scaling in areas exposed to repeated contact, occlusion, friction, pressure, gloves, cleansing products, or frequent hand hygiene. Acne, rosacea, eczema, urticaria, and other dermatologic conditions were differentiated according to their characteristic clinical morphology and distribution. Formal disease-specific diagnostic scoring systems were not applied.

For each participant, the dermatologists recorded the most likely clinical diagnosis, lesion morphology, associated symptoms, and anatomical site of involvement. Patch testing and skin biopsy were not performed; therefore, clinically diagnosed contact dermatitis could not be subclassified with certainty as irritant or allergic, and diagnoses were based on clinical evaluation.

## 2.6. Outcome Measures

The primary outcome was the prevalence of PPE-associated skin lesions among ICU healthcare workers. Secondary outcomes included the clinical diagnosis of lesions, lesion morphology, reported symptoms, and

anatomical distribution. Because participants could have more than one diagnosis, morphology, symptom, or affected anatomical site, these outcome categories were not mutually exclusive.

## 2.7. Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 24.0 (SPSS Inc., Chicago, IL, USA). The analysis was primarily descriptive because the study was designed to estimate the prevalence and describe the clinical characteristics of PPE-associated skin lesions. Continuous variables are presented as mean  $\pm$  standard deviation, whereas categorical variables are presented as frequencies and percentages. Percentages were calculated using the final analyzed sample of 68 participants as the denominator unless otherwise specified. Exact binomial 95% confidence intervals were calculated for prevalence estimates. Inferential analyses evaluating associations between participant characteristics and PPE-associated skin lesions were not performed because participant-level subgroup data were not available for reanalysis, only seven participants were classified as having no lesion, and exposure to several PPE components was nearly universal. These conditions provided insufficient variability and statistical power for reliable subgroup or multivariable analyses.

## 3. Results

### 3.1. Participant Characteristics and PPE Use

A total of 68 ICU healthcare workers were included in the final analysis. The demographic and occupational characteristics of the participants, as well as reported PPE use, are summarized in Table 1.

**Table 1.** Participant characteristics and PPE use among ICU healthcare workers.

| Variable                                        | Value            |
|-------------------------------------------------|------------------|
| Total participants                              | 68               |
| Age, years, mean $\pm$ SD                       | 41.27 $\pm$ 4.39 |
| Female sex, n (%)                               | 48 (70.6)        |
| Male sex, n (%)                                 | 20 (29.4)        |
| Physicians, n (%)                               | 16 (23.5)        |
| Nurses, n (%)                                   | 52 (76.5)        |
| Bachelor's degree, n (%)                        | 29 (42.6)        |
| Master's degree, n (%)                          | 23 (33.9)        |
| Medical specialist, n (%)                       | 16 (23.5)        |
| ICU employment duration, years, mean $\pm$ SD   | 6.29 $\pm$ 2.92  |
| Daily working time in ICU, hours, mean $\pm$ SD | 5.62 $\pm$ 1.18  |
| Surgical masks, n (%)                           | 12 (17.6)        |
| Other non-medical face masks, n (%)             | 3 (4.4)          |
| N95 respirators, n (%)                          | 61 (89.7)        |
| Face shields, n (%)                             | 58 (85.3)        |
| Goggles, n (%)                                  | 54 (79.4)        |
| Gloves, n (%)                                   | 68 (100.0)       |
| Gowns, n (%)                                    | 66 (97.1)        |

Note: Values are presented as mean  $\pm$  standard deviation or n (%). Percentages were calculated using the total analyzed sample (n = 68) as the denominator. PPE-use categories were not mutually exclusive.

### 3.2. Prevalence and Clinical Diagnoses of PPE-Associated Skin Lesions

PPE-associated skin lesions were identified in 61 of the 68 participants (89.7%; 95% CI, 80.0–95.8). Clinically diagnosed contact dermatitis was the most frequent diagnosis (77.9%), followed by acne (10.3%), eczema (7.4%), rosacea (5.9%), urticaria (4.4%), xerotic eczema (2.9%), seborrheic dermatitis (2.9%), atopic dermatitis (1.5%), and other dermatologic conditions (7.4%) (Table 2; Figure 1a).

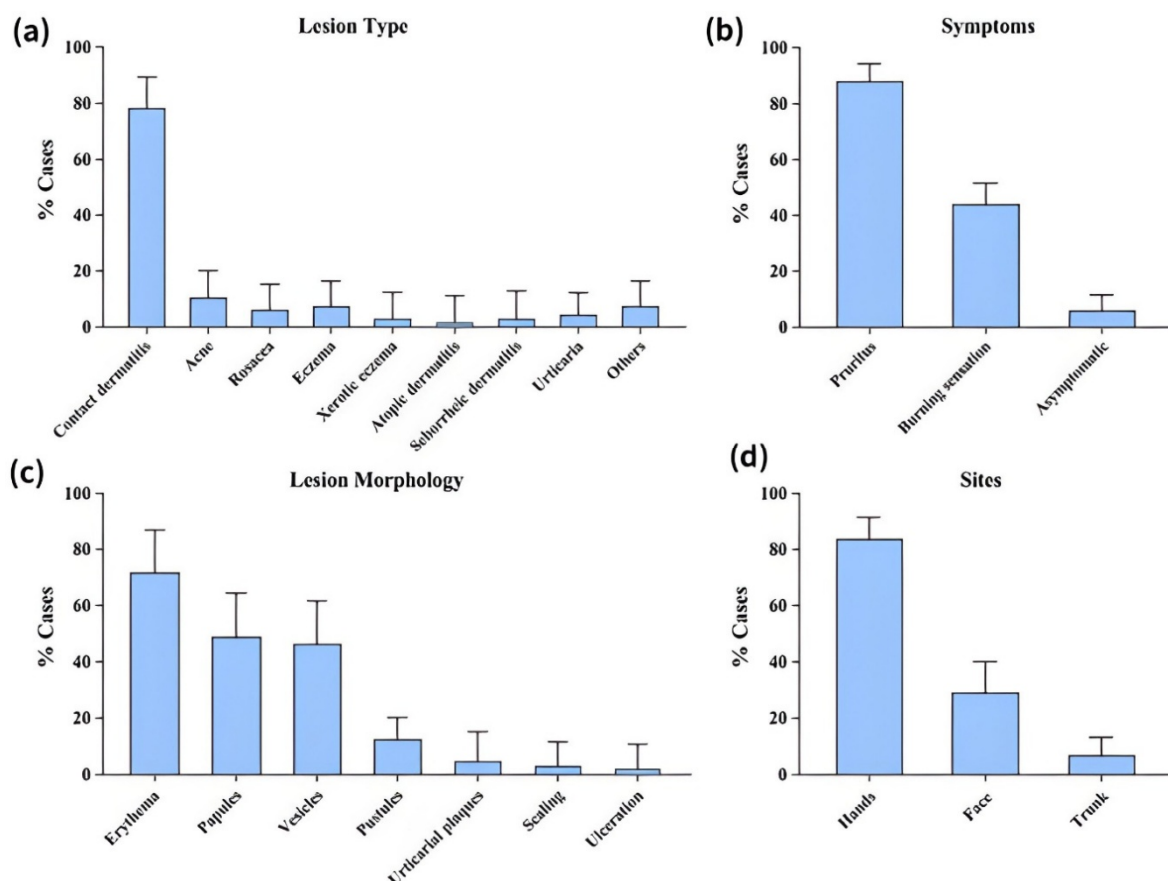
**Table 2.** Distribution of PPE-associated skin lesions among ICU healthcare workers.

| Domain             | Clinical Variable                       | n/N   | %    | 95% CI    |
|--------------------|-----------------------------------------|-------|------|-----------|
| Overall outcome    | Any PPE-associated skin lesion          | 61/68 | 89.7 | 80.0–95.8 |
| Clinical diagnosis | Clinically diagnosed contact dermatitis | 53/68 | 77.9 | 66.2–87.1 |
| Clinical diagnosis | Acne                                    | 7/68  | 10.3 | 4.2–20.1  |
| Clinical diagnosis | Eczema                                  | 5/68  | 7.4  | 2.5–16.3  |
| Clinical diagnosis | Rosacea                                 | 4/68  | 5.9  | 1.6–14.6  |

Table 2. Cont.

| Domain                  | Clinical Variable             | n/N   | %    | 95% CI    |
|-------------------------|-------------------------------|-------|------|-----------|
| Clinical diagnosis      | Urticaria                     | 3/68  | 4.4  | 0.9–12.4  |
| Clinical diagnosis      | Xerotic eczema                | 2/68  | 2.9  | 0.4–10.1  |
| Clinical diagnosis      | Seborrheic dermatitis         | 2/68  | 2.9  | 0.4–10.1  |
| Clinical diagnosis      | Atopic dermatitis             | 1/68  | 1.5  | 0.0–8.0   |
| Clinical diagnosis      | Other dermatologic conditions | 5/68  | 7.4  | 2.5–16.3  |
| Lesion morphology       | Erythema                      | 48/68 | 70.6 | 58.3–81.0 |
| Lesion morphology       | Papules                       | 33/68 | 48.5 | 36.0–61.2 |
| Lesion morphology       | Vesicles                      | 31/68 | 45.6 | 33.2–58.4 |
| Lesion morphology       | Pustules                      | 8/68  | 11.8 | 5.2–21.9  |
| Lesion morphology       | Urticarial plaques            | 3/68  | 4.4  | 0.9–12.4  |
| Lesion morphology       | Scaling                       | 2/68  | 2.9  | 0.4–10.1  |
| Lesion morphology       | Ulceration                    | 1/68  | 1.5  | 0.0–8.0   |
| Symptoms                | Pruritus                      | 60/68 | 88.2 | 78.1–94.8 |
| Symptoms                | Burning sensation             | 30/68 | 44.1 | 31.7–57.0 |
| Symptoms                | Asymptomatic                  | 4/68  | 5.9  | 1.6–14.6  |
| Anatomical distribution | Hands                         | 57/68 | 83.8 | 72.9–91.6 |
| Anatomical distribution | Face                          | 20/68 | 29.4 | 18.6–42.2 |
| Anatomical distribution | Trunk                         | 5/68  | 7.4  | 2.5–16.3  |

Note: Values are presented as n/N, percentage, and exact binomial 95% confidence interval. Percentages were calculated using the total analyzed sample (n = 68) as the denominator. Clinical diagnosis, morphology, symptom, and anatomical site categories were not mutually exclusive.



**Figure 1.** Distribution of PPE-associated skin lesions among ICU healthcare workers (n = 68). Panel (a) shows clinically diagnosed dermatologic conditions, panel (b) lesion morphology, panel (c) reported symptoms, and panel (d) anatomical distribution. Bars represent percentages calculated using the total analyzed sample (n = 68), and error bars indicate exact binomial 95% confidence intervals. Categories were not mutually exclusive.

### 3.3. Lesion Morphology

Erythema was the most frequent morphological finding (70.6%), followed by papules (48.5%), vesicles (45.6%), pustules (11.8%), urticarial plaques (4.4%), scaling (2.9%), and ulceration (1.5%) (Table 2; Figure 1b).

### 3.4. Symptoms

Pruritus was the most frequently reported symptom (88.2%), followed by burning sensation (44.1%). Four participants (5.9%) were asymptomatic (Table 2; Figure 1c).

### 3.5. Anatomical Distribution

The hands were the most commonly affected anatomical site (83.8%), followed by the face (29.4%) and trunk (7.4%) (Table 2; Figure 1d).

## 4. Discussion

In this cohort of ICU healthcare workers, PPE-associated skin lesions were common. A total of 61 participants (89.7%) had at least one clinically identified lesion. Clinically diagnosed contact dermatitis was the leading diagnosis, and pruritus, erythema, and hand involvement were the most frequent symptom, morphological finding, and anatomical site, respectively. Taken together, these findings suggest that repeated skin-barrier irritation from PPE use, hand hygiene, glove occlusion, and facial protective equipment is a central feature of the clinical pattern observed in respiratory infection ICUs. In this setting, symptomatic PPE-associated dermatoses should not be treated as incidental skin complaints, but as a relevant occupational health issue [8,13].

The prevalence in our cohort falls near the higher end of what has been reported for PPE-associated skin injury in healthcare workers. Lin et al. reported PPE-associated skin reactions in 74.5% of Chinese frontline healthcare workers during the COVID-19 pandemic, and systematic reviews have shown that such reactions are common when respirators, gloves, gowns, and eye protection are used for long periods. Our higher rate is not unexpected. The study was conducted in respiratory infection ICUs, where PPE exposure is sustained, hand hygiene is repeated throughout the shift, and skin recovery time is limited. ICU-specific reports point in the same direction; Mossel et al., for example, reported hand dermatitis among ICU nurses, supporting the view that critical-care staff have a distinct exposure pattern [7,9,15,16].

Clinically diagnosed contact dermatitis was the most frequent diagnosis, affecting 53 participants (77.9% of the total cohort). This result fits the exposure pattern of ICU work. Staff repeatedly wash or disinfect their hands, wear gloves for prolonged periods, and use masks or goggles that create friction and moisture beneath PPE. These conditions can weaken the stratum corneum, increase transepidermal water loss, and lead to erythema, burning, fissuring, and itching. Because patch testing was not included in the study protocol, clinically diagnosed contact dermatitis could not be subclassified as irritant or allergic. Nevertheless, the predominance of hand involvement, together with repeated occupational exposure to hand hygiene products and prolonged glove use, suggests that cumulative irritant dermatitis may have been the predominant mechanism in this cohort, although allergic sensitization cannot be excluded [1,6,8,17].

Pruritus and erythema were also central findings. Pruritus was reported by 60 participants (88.2%), making it the most common symptom, and erythema was the most frequent morphological feature. Both findings are consistent with repeated irritation, sweating, pressure, and friction during prolonged PPE use. Itching is particularly relevant in daily ICU work because it can prompt scratching, rubbing, or repeated adjustment of masks, goggles, or gloves during long shifts. These actions may worsen irritation and make PPE harder to tolerate. Erythema, in turn, may be an early visible sign of inflammation or mechanical stress, especially beneath tight respirators, goggles, or occlusive gloves. The high frequency of pruritus in this cohort suggests that symptom control should be part of occupational skin-protection strategies, not an afterthought [6–8,13].

Hand involvement was especially common in our cohort. Lesions were observed on the hands in 57 participants (83.8%), making this the most frequently affected anatomical site. This finding fits well with ICU practice, where repeated hand hygiene, exposure to soaps and alcohol-based disinfectants, prolonged glove use, sweating, and frequent glove changes all place stress on the skin barrier. Lin et al. reported a similar pattern, with hand involvement in approximately 84% of affected healthcare workers. Hand dermatitis is also a well-recognized occupational problem among healthcare personnel exposed to wet work and frequent disinfection. In respiratory infection ICUs, this risk may be even greater because hand hygiene and glove use are repeated during urgent bedside care, often with little time for the skin to recover [6,9,18].

Facial lesions were less common than hand lesions, but they were still seen in almost one-third of participants. In our cohort, 20 healthcare workers (29.4%) had facial involvement. This is plausible because N95 respirators, surgical masks, goggles, and face shields can create pressure, friction, heat, and occlusion over the nasal bridge, cheeks, periorbital area, and behind the ears. These conditions may lead to erythema, irritant dermatitis, acneiform eruptions, or flares of pre-existing conditions such as rosacea. Acne was recorded in 10.3% of participants, close to the 13.0% reported by Proietti et al. in an Italian multicenter study, but lower than the approximately 31% acne prevalence reported in a meta-analysis of mask-associated facial dermatoses. Differences between studies may reflect mask type, duration of wear, climate, baseline skin conditions, and how lesions were assessed. Less frequent diagnoses in our cohort, including eczema, rosacea, urticaria, xerotic eczema, seborrheic dermatitis, and atopic dermatitis, should still be considered clinically relevant when they cause symptoms under tight-fitting facial PPE [7,13,19–21].

The ICU setting itself probably contributed to the high frequency of lesions in this study. Participants worked in respiratory infection ICUs, where PPE is used repeatedly during bedside care, aerosol-generating procedures, and close contact with critically ill patients. These duties also require frequent hand hygiene, repeated glove changes, and prolonged use of respirators or eye protection. During urgent clinical tasks, staff may have little opportunity to remove PPE or allow the skin to dry and recover. Heat, sweating, physical workload, and stress may add to this irritation during a shift. For these reasons, respiratory ICUs may expose healthcare workers to a pattern of skin injury that differs from less intensive clinical settings [3,6,10,15].

Although subgroup analyses according to profession, sex, and individual PPE components would have been informative, the modest sample size, the small number of participants without lesions, and the high prevalence of exposure to key PPE items limited the variability and statistical power required for robust comparisons. Larger multicenter studies with detailed participant-level exposure data are needed to identify independent occupational and demographic risk factors.

These findings point to several practical prevention measures. Because hand involvement and clinically diagnosed contact dermatitis were the predominant findings, protecting the hand-skin barrier should be prioritized. Potential preventive approaches include scheduled application of fragrance-free moisturizers, particularly after handwashing and at the end of work shifts; appropriate use of barrier creams when compatible with infection-control procedures; selection of well-fitting, non-irritating gloves; and optimization of respirator and goggle fit. Thin silicone-based protective dressings may also be considered at pressure-prone facial sites, provided that they do not compromise respirator fit or protective performance. Establishing early-access occupational dermatology referral pathways may support timely diagnosis, individualized skin-care advice, and prevention of persistent occupational dermatitis. These measures were not evaluated in the present study and should therefore be considered potential practice-oriented strategies rather than proven outcomes of this cohort [6–8,13,17].

The relevance of these lesions is not only dermatologic. In daily ICU work, itching, burning, or painful hand lesions can make gloves, respirators, and repeated hand hygiene harder to tolerate. Workers may rub the skin or adjust masks and goggles more often when symptoms are active. This study did not measure work performance, absenteeism, quality of life, or PPE adherence, so these outcomes cannot be inferred from our data. Even so, the high frequency of symptomatic lesions suggests that skin health should be included in occupational health and infection-prevention planning for ICU staff [6–8,13].

For occupational health teams, the main message is practical. Hands should be checked carefully, and early symptoms such as itching, erythema, and burning should not be ignored. Hospitals could add brief skin checks, simple education on barrier protection, and clear referral pathways for workers with persistent or recurrent lesions. These steps are especially relevant in respiratory ICUs, where prolonged PPE use is likely to continue during outbreaks and during care for patients with transmissible respiratory infections [8].

This study has several limitations. First, its cross-sectional design prevents confirmation of temporal or causal relationships between PPE exposure and skin lesions. Although all participants underwent direct dermatologic examination, symptoms and exposure histories were partly self-reported and may have been affected by recall bias. Second, recruitment was based on eligible healthcare workers who were available and agreed to participate, and complete records of the numbers approached and declining participation were not available; therefore, selection bias cannot be excluded. Third, detailed occupational exposure and skin-care variables, including the duration of PPE wear, cumulative respirator use, frequency of handwashing and sanitizer use, moisturizer use, glove material, previous dermatologic disease, and history of atopy, were not systematically recorded. Fourth, patch testing and skin biopsy were not performed, preventing definitive differentiation between irritant and allergic contact dermatitis and confirmatory classification of other clinically diagnosed conditions. Although disagreements were resolved through consultation with a third dermatologist, interobserver agreement was not formally quantified. Fifth, lesion severity and dermatology-specific quality of life were not evaluated using validated instruments, limiting assessment of the functional and psychosocial impact of the observed skin conditions. Finally,

the modest sample size, the small lesion-negative group, and the near-universal use of several PPE components limited subgroup and multivariable analyses. The findings are derived from a regional cohort and may not be directly generalizable to other healthcare systems, climates, occupational practices, or PPE protocols.

Overall, PPE-associated skin lesions were frequent and symptomatic in this group of ICU healthcare workers. The pattern was dominated by contact dermatitis, pruritus, erythema, and hand involvement, suggesting repeated skin-barrier irritation from hand hygiene, glove occlusion, and facial protective equipment. These findings support a practical message for critical-care settings: occupational skin problems should be identified early and managed before they become persistent. Future studies should include larger multicenter samples, better exposure measurement, longitudinal follow-up, patch testing, quality-of-life assessment, and evaluation of skin-protection interventions.

## 5. Translational Insight

The findings from this ICU cohort give a clear practical message. PPE-associated skin lesions were common, and the main problems were clinically diagnosed contact dermatitis, pruritus, erythema, and hand involvement. Skin-protection efforts should therefore start with the hands and the skin barrier. Ready access to fragrance-free moisturizers, skin-friendly cleansing products, appropriate glove selection, better respirator and goggle fit, and early assessment of irritation may help staff tolerate prolonged PPE use. In respiratory ICUs, these measures should be part of routine occupational health and infection-control practice rather than being considered only after lesions become severe.

## 6. Conclusions

PPE-associated skin lesions were common in this regional cohort of ICU healthcare workers, with clinically diagnosed contact dermatitis, pruritus, erythema, and hand involvement representing the predominant findings. The observed clinical pattern was compatible with repeated occupational skin-barrier irritation associated with frequent hand hygiene, glove use, and prolonged wear of facial protective equipment; however, the cross-sectional design does not establish causality. These findings support early dermatologic assessment and practical skin-protection strategies in critical-care settings. Nevertheless, the results from this single regional cohort may not be directly generalizable to other healthcare systems, climates, or PPE protocols. Larger longitudinal multicenter studies with detailed exposure assessment, confirmatory diagnostic testing, severity scoring, and quality-of-life evaluation are needed.

## Author Contributions

Conceptualization, A.A. and F.I.; methodology, A.A., A.H.S., Z.M. and F.I.; investigation, A.A., A.H.S. and Z.M.; data curation, A.A. and S.M.H.; formal analysis, S.M.H.; writing—original draft preparation, A.A.; writing—review and editing, A.A., A.H.S., Z.M., S.M.H. and F.I.; supervision, F.I.; project administration, F.I. All authors have read and agreed to the published version of the manuscript.

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## Institutional Review Board Statement

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and was approved by the Ethics Committee of Isfahan University of Medical Sciences (Approval No. IR.MUI.MED.REC.1400.176).

## Informed Consent Statement

Written informed consent was obtained from all participants before enrollment in the study.

## Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy and ethical restrictions.

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## Conflicts of Interest

The authors declare no conflict of interest.

## Use of AI and AI-Assisted Technologies

During the preparation and revision of this work, the authors used ChatGPT (OpenAI) for language editing and draft refinement. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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