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Review

Clinical Patterns of Contact Dermatitis in Populations With High Occupational Exposure

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Abstract

Occupational contact dermatitis is a significant contributor to work-related morbidity across multiple industries, particularly those involving repeated exposure to irritants, allergens, or physical stressors. The clinical patterns of dermatitis in high-risk populations are shaped by the nature and duration of exposures, anatomical sites of contact, and individual susceptibility. Wet work, chemical handling, protective gloves, and poor ventilation frequently intersect in industries such as healthcare, food processing, cosmetology, construction, and manufacturing, driving both irritant and allergic forms of dermatitis. The onset is often insidious, with symptoms ranging from mild erythema and scaling to chronic lichenified plaques and painful fissures, commonly misattributed or underreported. Diagnostic challenges arise due to the overlapping features of allergic and irritant dermatitis, and the complexity of workplace chemical profiles. Patch testing, though essential, remains underutilized in many occupational settings. Management requires not only pharmacologic control but also modification of exposure environments, often necessitating cooperation between dermatologists, occupational physicians, and employers. Preventive strategies that focus on worker education, accurate hazard identification, and appropriate use of personal protective equipment are essential but inconsistently implemented. Evidence supports the effectiveness of integrated prevention programs, particularly when tailored to specific work environments and reinforced through regular training. The persistence and recurrence of occupational contact dermatitis contribute to reduced work productivity, psychological distress, and, in severe cases, job loss. Broader adoption of interdisciplinary approaches, early screening, and structured return-to-work protocols may reduce the long-term burden. As research continues to explore biomarkers of susceptibility and digital tools for early detection, the potential for personalized preventive strategies grows. Understanding clinical patterns within occupational groups remains central to improving both diagnostic accuracy and management outcomes in affected populations.

Keywords: occupational contact dermatitis, irritant exposure, allergic sensitization, workplace skin disease, preventive strategies

Introduction

Contact dermatitis is a prevalent inflammatory skin condition resulting from direct exposure to environmental agents, often exacerbated by occupational hazards. It is broadly categorized into two types: irritant contact dermatitis (ICD) and allergic contact dermatitis (ACD), each with distinct pathophysiological mechanisms. While ICD results from non-immunologic damage to the skin barrier, ACD is a delayed-type hypersensitivity reaction following sensitization to a specific allergen. Both forms can significantly impair quality of life, especially when recurrent or chronic, and are among the most common work-related skin diseases globally (1).

Populations with high occupational exposure, such as healthcare workers, construction workers, hairdressers, agricultural laborers, and cleaners, are disproportionately affected due to regular contact with irritants and sensitizing agents. For instance, frequent hand washing and exposure to disinfectants place healthcare professionals at heightened risk of ICD, while exposure to rubber chemicals, hair dyes, and resins may trigger ACD in other occupations. In many of these professions, repetitive exposure without adequate skin protection or recovery time leads to cumulative skin damage and inflammation (1).

The prevalence of contact dermatitis in occupational settings is influenced by both intrinsic and extrinsic factors. Intrinsic factors include individual susceptibility, genetic predisposition, and history of atopic dermatitis. Extrinsic contributors involve the type and duration of exposure, the concentration of irritants or allergens, use of personal protective equipment (PPE), and hygiene practices. Studies have shown that inadequate PPE use, especially in sectors with frequent wet work, significantly elevates the risk of chronic skin changes and sensitization (1, 2). Moreover, the chemical complexity of workplace substances can complicate the identification of specific triggers and delay appropriate diagnosis.

Clinical presentations of contact dermatitis in occupationally exposed populations can vary widely. Common manifestations include erythema, scaling, fissuring, vesiculation, and lichenification. The hands are most frequently involved due to their direct contact role in occupational tasks. However, distribution can extend to other areas based on exposure patterns and routes, including airborne spread of allergens. Misdiagnosis or delayed diagnosis can lead to prolonged morbidity and even job change or loss, underlining the importance of timely dermatologic evaluation and patch testing (2).

The economic and psychological burdens of occupational contact dermatitis are substantial. Costs related to treatment, absenteeism, job retraining, and compensation claims underscore its public health significance. In several industrialized countries, occupational dermatitis is one of the most frequently reported work-related illnesses, with a marked impact on productivity and worker well-being (3). Despite increasing awareness, underreporting remains a significant barrier to adequate surveillance and prevention.

Preventive strategies require a multifaceted approach including worker education, engineering controls, proper PPE use, substitution of harmful agents, and routine dermatologic surveillance. Regulatory bodies and employers play a critical role in implementing and monitoring workplace safety standards. In addition, dermatologists must maintain a high index of suspicion when evaluating patients from high-risk occupations presenting with dermatitis symptoms, even when the clinical presentation is non-specific. Given the dynamic nature of occupational environments and evolving exposure risks, continuous research is essential to update diagnostic strategies and refine prevention models. Understanding clinical patterns across different professions provides insight into exposure-response relationships and informs effective management pathways (4).

Review

Occupational contact dermatitis demonstrates significant variability in clinical patterns depending on the nature, duration, and intensity of workplace exposures. Workers engaged in wet work, such as

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those in healthcare, food services, and cleaning industries, frequently develop irritant contact dermatitis due to repetitive exposure to water, detergents, and disinfectants. These agents compromise the epidermal barrier, especially when exposure is chronic and combined with mechanical friction. In contrast, occupations involving exposure to resins, metals, rubber, and preservatives are more likely to induce allergic contact dermatitis through sensitization mechanisms. Notably, airborne allergens such as epoxy resins or isocyanates can lead to widespread dermatitis beyond direct contact sites, posing diagnostic challenges and often resulting in under-recognition of occupational etiology (5). Studies have also highlighted differences in presentation and severity between sexes and age groups, with younger workers often more vulnerable due to insufficient protective habits and skin adaptation. Furthermore, dermatologic symptoms can persist long after exposure cessation, indicating the potential for chronic disease courses and recurrent flares upon re-exposure (6, 7).

Occupational Risk Factors and Exposure Profiles

Occupational contact dermatitis arises from complex interactions between environmental exposures and individual susceptibility, often dictated by the specific nature of professional tasks. High-risk occupations frequently involve either chronic exposure to irritants or intermittent contact with sensitizing agents, and in many cases, both contribute concurrently to disease development. In industrial manufacturing, workers are routinely exposed to cutting fluids, metalworking fluids, and degreasers demonstrate high prevalence rates of irritant contact dermatitis. These substances not only contain potent surfactants and hydrocarbons but are often contaminated with microbial products and metal salts, compounding their dermatotoxic potential. Even trace amounts, under conditions of sustained exposure, can degrade the stratum corneum's integrity and provoke inflammation. These risk profiles are compounded by inadequate ventilation, inconsistent use of gloves, and extended shifts that limit recovery time for damaged skin (7).

The cosmetic and beauty industries provide a contrasting but equally instructive context. Hairdressers, for example, face daily exposure to a broad spectrum of allergens including p-phenylenediamine, ammonium persulfate, and formaldehyde-releasing preservatives. A high rate of sensitization is consistently observed in this population, often beginning during apprenticeships due to early, unprotected exposure. Sensitization in these workers often involves the dorsal hands, wrists, and forearms, reflecting the anatomical distribution of exposure during tasks such as dye application and shampooing. In this group, gloves are commonly worn but frequently breached, removed, or reused, allowing allergen penetration and prolonging contact duration (8).

Agricultural and horticultural laborers operate in yet another challenging dermatologic environment, where direct handling of soil, fertilizers, and pesticides imposes a dual threat of irritation and allergic dermatitis. The seasonal variability of exposures, combined with climatic conditions such as humidity, wind, and ultraviolet radiation, shapes the clinical expression of contact dermatitis in these settings. Workers may also encounter plant-derived allergens such as sesquiterpene lactones and thiurams used in rubber gloves, which can induce delayed-type hypersensitivity reactions. Furthermore, the use of shared tools and poor access to handwashing facilities increase the persistence of these agents on the skin's surface, amplifying both irritating and allergenic potential (9).

Among healthcare workers, the primary risks stem from frequent hand hygiene practices, alcohol-based sanitizers, and prolonged glove use. Recurrent exposure to antiseptics like chlorhexidine and iodine, along with latex or nitrile gloves, has been shown to result in both cumulative irritant reactions and Type IV hypersensitivity. Importantly, the pressure to maintain rigorous infection control protocols often leads to over washing, which strips the skin of its lipid barrier. Studies conducted during recent pandemic responses demonstrated a surge in occupational dermatitis cases among frontline staff, often

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correlated with an increase in hand hygiene frequency and PPE use (10).

Variability in Clinical Manifestations Across Occupational Groups

Dermatitis patterns in workplace settings often reflect the invisible architecture of labor such as how tools are held, chemicals applied, and hours spent in repetitive motions. Construction laborers, for example, are exposed to cement, epoxy resins, and chromates, all of which are well-documented sensitizers or irritants. Hexavalent chromium, a frequent component of wet cement, is among the most potent allergens encountered in construction, with documented sensitization rates reaching up to 10% in some populations (11). Prolonged contact without adequate barrier protection enables these agents to penetrate the epidermal layers, where immune activation can evolve over time.

In electronics and precision manufacturing sectors, dermatitis frequently emerges from exposure to acrylates and epoxy-based compounds, many of which are used in soldering, coatings, and optical components. The low molecular weight and high skin permeability of acrylates make them particularly hazardous in settings where micro-exposures accumulate unnoticed. Workers handling adhesives or light-cured materials, such as dental technicians and circuit board assemblers, often present with hand eczema or periungual dermatitis after months of seemingly benign contact (12). Glove breakthrough and vapor-phase sensitization add to the complexity, especially in environments where ambient exposure is underestimated.

Cleaners and janitorial staff present a distinct dermatologic profile shaped by frequent wet work and surfactant-rich solutions. The cumulative effect of detergents, bleaches, and disinfectants accelerates trans-epidermal water loss and strips the skin of protective lipids. Inadequate recovery time between shifts and the expectation of performing tasks quickly contribute to lower glove adherence, even when protective equipment is provided. Studies have shown that even short exposures to diluted sodium hypochlorite can disrupt keratinocyte cohesion and induce inflammatory changes, particularly in colder climates where ambient humidity is low (13). Given the rotational nature of cleaning jobs, workers may also be exposed to a broad chemical spectrum within a single shift, complicating patch test interpretation.

Food processing environments introduce further variables, including cold exposure, constant handwashing, and raw ingredient contact. Proteolytic enzymes in seafood, meat preservatives, and spices act not only as irritants but also as allergens, with case reports of ACD linked to garlic, paprika, and fish proteins. The frequent use of powder-free latex gloves in this sector brings the risk of latex allergy into the mix, particularly when paired with occlusion, heat, and moisture. Workers in this domain are often subject to informal employment arrangements, which has been correlated with reduced access to occupational health assessments and delayed diagnosis of dermatologic conditions (14, 15).

Implications for Diagnosis, Management, and Preventive Strategies

Diagnostic precision in occupational contact dermatitis relies heavily on the integration of clinical expertise with occupational hygiene knowledge. Skin symptoms often overlap across etiologies, making it difficult to attribute causality without systematic exposure assessment. Temporal relationships between symptom onset and work shifts, improvement during periods away from work, and identification of specific workplace substances form the backbone of diagnostic reasoning. Standardized workplace-oriented patch testing batteries have improved relevance in recent years, yet many workers are never referred for evaluation, especially in sectors where dermatologic support is peripheral to occupational health services (16).

Management decisions must be shaped by both symptom control and exposure elimination. Acute episodes can often be managed effectively with high-potency topical corticosteroids and emollient therapy. Yet therapeutic success is limited in cases where exposure persists. In some industries, even modest adjustments can significantly reduce flare

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frequency. Task rotation and shorter exposure durations have also been proposed to mitigate risk without impacting productivity. While rarely used outside regulated settings, barrier creams formulated for specific industrial hazards may offer additional value when combined with protective equipment, particularly where gloves are impractical (17).

Communication between dermatologists, employers, and workers remains central to sustainable management. Fragmentation in responsibility often leads to delayed action or recurrence, particularly in cases where job modification is required. Occupational physicians play a critical role here, bridging clinical recommendations and workplace realities. Interdisciplinary skin health programs have shown promising outcomes in reducing long-term disability, especially when they include structured return-to-work planning and regular skin monitoring. However, these programs are often absent in small or informal workplaces, leaving workers to navigate flare-ups independently, often resulting in job abandonment or dismissal without proper compensation (18).

Prevention models gain traction when they are embedded into workplace culture. Mandatory training modules, hazard labeling, skin condition screening during pre-employment evaluations, and data logging of exposure incidents all contribute to a more proactive approach. Technological interventions, such as wearable skin sensors or mobile apps for symptom tracking, are under exploration as adjuncts to early detection efforts. Although not yet standard practice, their potential to bridge the communication gap between workers and clinicians is being evaluated in pilot studies. In parallel, ongoing research into genetic and immunologic markers may soon refine the prediction of susceptibility, leading to more tailored occupational placement strategies in high-exposure fields (19).

Conclusion

Occupational contact dermatitis remains a widespread yet preventable condition rooted in specific exposure profiles across diverse industries. Early recognition, accurate diagnosis, and collaborative management are essential to minimize its impact. Protective strategies must extend beyond compliance, integrating education, equipment, and surveillance. Strengthening interdisciplinary approaches will be key to reducing the burden on workers and healthcare systems alike.

Disclosure

Conflict of interest

There is no conflict of interest.

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Ethical consideration

Non applicable.

Data availability

Data that support the findings of this study are embedded within the manuscript.

Author contribution

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

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