

## Navigating the Complexities of Pigmented Contact Dermatitis: An Integrated Review

Therese Limbana OMS IV<sup>1\*</sup>, Grace Ansah OMS DO<sup>2</sup>, Caleb Sooknanan OMS II<sup>1</sup>, Joelle Lee DO<sup>3</sup>

<sup>1</sup>New York Institute of Technology College of Osteopathic Medicine, Old Westbury, NY

<sup>2</sup>Department of Dermatology, Trinity Health Livingston, Ypsilanti, MI

<sup>3</sup>Department of Dermatology, St. John's Episcopal Hospital, Far Rockaway, NY

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**Citation:** *Therese Limbana OMS IV, Grace Ansah OMS DO, Caleb Sooknanan OMS II, Joelle Lee DO. Navigating the Complexities of Pigmented Contact Dermatitis: An Integrated Review. Int Clin Med Case Rep Jour. 2025;4(2):1-12.*

**Received Date:** 15 February, 2025; **Accepted Date:** 21 February, 2025; **Published Date:** 23 February, 2025

**\*Corresponding author:** Therese Limbana OMS IV, ew York Institute of Technology College of Osteopathic Medicine, Old Westbury, NY

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### 1. ABSTRACT

Pigmented Contact Dermatitis (PCD) is a challenging dermatological condition marked by lasting hyperpigmented skin patches, primarily caused by exposure to certain chemicals and allergens. This comprehensive review synthesizes the latest understanding of PCD, covering its causes, presentation, diagnosis, and management. PCD arises from a complex interaction between environmental factors, individual sensitivity, and direct contact with irritants such as fragrances, preservatives, and dyes. The clinical profile of PCD includes distinct hyperpigmented patches or macules, necessitating careful differential diagnosis from other skin conditions. Effective diagnosis relies on patch testing combined with a detailed clinical examination. Management strategies are centered on avoiding triggers, employing topical and systemic treatments, and educating patients about their condition. The review also discusses the development of new treatments and preventive measures, indicating a significant shift towards identifying genetic predispositions and advancing therapeutic options.

**Keywords:** Pigmented contact dermatitis; Chemical irritants; Patch testing; Hyperpigmentation; Dermatological management; Allergens in cosmetics; Environmental exposures; Diagnostic methodologies

### 2 INTRODUCTION

#### 2.1 BACKGROUND INFORMATION

PCD is a distinctive form of contact dermatitis characterized by the appearance of patches on the skin, primarily resulting from prolonged exposure to certain chemicals or allergens.<sup>[1]</sup> Unlike other forms of dermatitis that primarily manifest as red, itchy, and inflamed skin, PCD predominantly affects the pigmentation of the skin, leading to a lasting discoloration even after the initial irritation subsides.<sup>[2]</sup> The various colors of PCD seen on physical examination can be grayish-brown, slate-colored, or reddish-brown, and the pigmentation of PCD can have a reticulated, patchy, or follicular pattern.<sup>[3,4]</sup> While first discovered by Riehl in 1917, the condition was initially delineated by Osmundsen in 1970, highlighting its unique clinical presentation compared to the more

common forms of contact dermatitis, such as allergic contact dermatitis (ACD) and irritant contact dermatitis (ICD).<sup>[5-7]</sup>

Epidemiologically, PCD has been reported with varying prevalence across different geographic regions and populations, suggesting that environmental, occupational, and genetic factors play a significant role in its manifestation. While comprehensive global epidemiological data are scarce, this condition commonly occurs in women of middle age with dark skin, with an estimated prevalence rate of 2 to 10% in the general population.<sup>[6,8]</sup> Initially reported in Japan, other countries such as India, Denmark, South America, France, and South Africa have also reported similar cases.<sup>[8]</sup> This can be attributed to the widespread use of skin-lightening products and cosmetics containing potent allergens like fragrances and preservatives.<sup>[10]</sup> Occupational exposure to industrial chemicals and dyes has also been identified as a significant risk factor, especially among workers in the textile, cosmetics, and manufacturing sectors.<sup>[6,11]</sup> An understanding of how to treat PCD in people of color is especially important, given that the associated skin response is affected by the particular properties of the exposing agent, the nature and duration of skin contact, and the patient's susceptibility to the condition.<sup>[9]</sup>

## 2.2 PURPOSE OF THE REVIEW

The increasing incidence of PCD across diverse demographics and geographies necessitates a thorough examination of its etiology, clinical manifestations, and management strategies. This literature review aims to consolidate current knowledge and emerging research on PCD, with specific objectives to enhance understanding among healthcare professionals and improve patient outcomes. A key focus is to dissect the complex interplay between environmental exposures, individual susceptibilities, and the broader socio-economic factors contributing to the disease burden.

Additionally, this review seeks to address the pressing need for an updated synthesis of information regarding PCD. The rapid evolution of cosmetic and industrial formulations, coupled with global shifts in lifestyle patterns, has introduced a myriad of new chemical entities into everyday life, potentially exacerbating the prevalence and severity of PCD.<sup>[12]</sup> The emergence of novel irritants, alongside changes in occupational and environmental exposures, underscores the urgency for healthcare professionals to stay aware of the latest developments in the diagnosis and management of PCD.<sup>[8]</sup>

Moreover, this review intends to highlight the need for standardized diagnostic criteria and treatment protocols. Despite its increasing recognition, PCD remains under-diagnosed and inconsistently managed, partly due to the variability in clinical presentation and the lack of consensus on effective interventions.<sup>[3]</sup> Given the multifaceted nature of PCD, this review is strategically focused on four critical domains: clinical manifestations, causative agents, diagnostic methodologies, and available treatment options. By providing a comprehensive overview of the current state of knowledge, this review aims to foster a more uniform approach to managing PCD, enhancing the quality of care for affected individuals.

## 3 RESULTS

### 3.1 ETIOLOGY AND RISK FACTORS

The pathogenesis of PCD is a complex interplay of environmental exposures, individual susceptibility, and direct contact with specific chemical agents.<sup>[1,6,10,11]</sup> Central to the development of PCD are various chemical irritants and allergens, which, upon exposure, incite a delayed hypersensitivity reaction, leading to the characteristic pigmented lesions.<sup>[4]</sup> Prominent among these triggers are fragrances, commonly found in cosmetics and personal care products, which contain complex mixtures of volatile compounds capable of eliciting an allergic response.<sup>[3,4]</sup> Fragrance components that may be possible allergens for PCD include benzyl-salicylate, ylang-ylang oil, jasmine absolute, hydroxycitronellal, and benzyl alcohol.<sup>[13]</sup> Preservatives such as parabens and formaldehyde releasers, employed to extend the shelf life of products, have also been implicated in PCD due to their allergenic potential.<sup>[15,16]</sup> Examples of preservatives that may possibly cause PCD include formaldehyde, cetrimonium bromide, and thimerosal.<sup>[13]</sup> Additionally, dyes, especially those used in textiles and hair colorants, such as paraphenylenediamine (PPD), have been identified as significant contributors to PCD cases, reflecting the broad spectrum of chemicals capable of inducing this condition.<sup>[3,4,6]</sup> Examples of textile substances that could be potential allergens include Tinopal CH3566, naphthol AS, mercury compounds, and azo dyes.<sup>[13]</sup>

The etiology of PCD has been proposed to be connected with multiple factors. For instance, contact dermatitis may be associated with inflammatory states seen with type IV hypersensitivity reactions, which may cause disruptions in melanin synthesis, distribution, and degradation; such disturbances may lead to the phagocytosis of melanin granules.<sup>[1]</sup> Aside from this, PCD can also be linked with autoimmune reactions, with keratinocyte antibodies possibly destabilizing the extracellular matrix, which would thereby render patients more vulnerable to immune dysregulation.<sup>[1]</sup>

Although scarce, several case reports have highlighted the development of PCD upon exposure to chemicals found in sunscreens with benzyl salicylate being frequently associated with PCD.<sup>[13]</sup> Sunscreen use has increased over time due to heightened awareness of the harmful effects of ultraviolet (UV) radiation.<sup>[8]</sup> Given the growing demand for sunscreens to contain a variety of components, including high sun protection factor (SPF) and broad spectrum UV coverage, while also having easy spreadability and minimal odor, the complexity of ingredients added to sunscreens has risen, leading to increased reports of adverse effects.<sup>[8]</sup>

Beyond personal care products, environmental and occupational exposures represent critical risk factors for PCD. Individuals working in industries that involve frequent contact with potential irritants and allergens, such as the textile, cosmetic, and manufacturing sectors, are at elevated risks of developing PCD.<sup>[14]</sup> These occupational hazards underscore the importance of workplace safety measures and personal protective equipment in mitigating the risk of PCD. Moreover, environmental factors, including air pollution and plant allergens, have been suggested to contribute to the onset of PCD, highlighting the multifactorial nature of environmental risk factors.<sup>[17,18]</sup>

The role of genetic predisposition and skin type in the susceptibility to PCD is an area of ongoing research. While the exact genetic markers associated with PCD remain to be fully explored, there is evidence to suggest that certain genotypes may confer increased sensitivity to the allergens and irritants commonly responsible for PCD.<sup>[4,6]</sup> For example, elevated guanine deaminase function may be linked with basement membrane and

keratinocyte damage that may be associated with the condition.<sup>[1]</sup> Also, individuals with specific skin types, particularly those with a higher melanin content, may exhibit a predisposition to more pronounced pigmentation changes following dermatitis, thereby exacerbating the appearance of PCD.<sup>[5]</sup>

### 3.2 CLINICAL MANIFESTATIONS

PCD displays a distinct clinical phenotype, which, while characteristic, can pose diagnostic challenges due to similarities with other dermatologic conditions.<sup>[6,17,19-21]</sup> PCD predominantly manifests as hyperpigmented patches or macules, ranging in color from dark brown to grayish-blue, which can persist or intensify over time.<sup>[5,14]</sup> The lesions typically exhibit ill-defined borders and are mostly located on areas of the skin that are exposed to the offending agent, such as the face, neck, and hands. This localization is particularly prevalent among individuals who use cosmetics or fragrances containing irritants or allergens implicated in PCD.<sup>[22]</sup> In addition to discoloration, patients may report mild to moderate pruritus, although the absence of significant itching distinguishes PCD from more inflammatory forms of contact dermatitis.<sup>[26]</sup> Notably, the chronic nature of exposure and the delayed hypersensitivity response contribute to the gradual onset and persistence of pigmentation changes, complicating the early recognition of PCD.<sup>[6,28]</sup>

Distinguishing PCD from other pigmented dermatologic conditions necessitates a thorough clinical evaluation, as several disorders share overlapping features with PCD. Melasma, for instance, is characterized by symmetrical hyperpigmented patches on sun-exposed areas but lacks a direct association with contact allergens central to PCD.<sup>[19]</sup> Post-inflammatory hyperpigmentation (PIH) similarly presents with darkened skin areas following inflammatory conditions but is differentiated by its history of preceding inflammation or injury.<sup>[20]</sup> Furthermore, lichen planus pigmentosus and erythema dyschromicum perstans are considered in the differential diagnosis due to their presentation with persistent pigmented lesions, yet these conditions exhibit distinct histopathological findings and are not typically associated with external allergens or irritants.<sup>[6,21]</sup> Exogenous ochronosis is another condition to be considered for diagnosis; while it is associated with blue-black pigmentation, it is linked with the application of skin creams containing hydroquinone or phenol.<sup>[23]</sup> Drug-induced melanoderma can be observed separately with hydroxyurea therapy among other medications.<sup>[24]</sup> For example, a case report indicated that melanodermal spots were observed on the upper extremities, lower extremities, abdomen, and oral cavity of a female patient who presented with systemic lupus erythematosus and was subsequently treated with hydroxychloroquine.<sup>[25]</sup>

### 3.3 DIAGNOSIS AND EVALUATION

The diagnosis and evaluation of PCD necessitate a multifaceted approach, integrating clinical judgment with diagnostic testing to accurately identify the condition and its causative agents. This comprehensive assessment is crucial for formulating an effective management plan tailored to the individual patient.<sup>[6,14]</sup> The cornerstone of diagnosing PCD is a thorough clinical history and physical examination. Detailed patient history should focus on the onset and progression of skin changes, prior incidents of dermatitis, exposure to potential irritants or allergens, and the use of cosmetics, fragrances, or topical and oral medications.<sup>[29]</sup> Additionally, lifestyle factors, occupational hazards, and familial history of dermatological conditions can offer valuable insights into potential

risk factors. The physical examination should meticulously document the location, color, size, and pattern of the pigmented lesions, with particular attention to areas typically exposed to allergens.<sup>[30]</sup> This initial clinical assessment is pivotal for guiding further diagnostic investigations and differentiating PCD from other pigmented skin conditions.

Patch testing stands as a critical diagnostic tool for identifying specific allergens responsible for PCD.<sup>[15]</sup> By applying small quantities of common allergens to the skin under occlusive patches, healthcare providers can observe reactions indicative of allergic contact dermatitis.<sup>[15,32]</sup> Positive reactions are characterized by localized dermatitis at the test site, correlating with the patient's exposure history to identify relevant allergens. Despite its utility, patch testing requires careful interpretation, as false positives and negatives can occur.<sup>[16]</sup> It is also important to include a comprehensive panel of allergens relevant to the patient's environmental and occupational exposures to ensure the identification of potential irritants.

While not routinely employed in the diagnosis of PCD, auxiliary diagnostic tools such as imaging and histopathology can provide additional insights, particularly in atypical cases.<sup>[3,10,33]</sup> Dermoscopy may reveal specific patterns of pigmentation that support a diagnosis of PCD, although its findings are not pathognomonic.<sup>[33]</sup> Histopathological examination of skin biopsies may indicate increased epidermal melanocytes and pigment incontinence, vacuolar basal layer degeneration, and a lymphocytic infiltrate with minimal to mild spongiosis.<sup>[3,5,27]</sup> Other histopathological findings of PCD can include basal cell liquefaction with melanophages in the papillary dermis. Researchers have suggested the liquefaction may be a result of fragrances producing a type IV cytolytic reaction in the epidermal basal layer.<sup>[4]</sup> However, the invasive nature of biopsy and the requirement for specialized interpretation limit its routine use.

### **3.4 MANAGEMENT AND TREATMENT**

Effective management of PCD requires a multifaceted approach, focusing on trigger avoidance, symptom management through topical and systemic therapies, and patient education.<sup>[6,16,17]</sup> The goal of treatment is not only to alleviate current symptoms but also to prevent future episodes by minimizing exposure to causative agents. A thorough assessment of the patient's environment, occupational hazards, and personal care products is essential for pinpointing potential triggers.<sup>[6,17]</sup> Once identified, patients should be advised to eliminate or substitute these products with hypoallergenic alternatives to reduce the risk of recurrence. Avoidance strategies have been shown to significantly improve outcomes in PCD patients and are considered the most effective measure in the long-term management of the condition.<sup>[34]</sup>

Topical treatments play a pivotal role in symptomatic relief. Topical corticosteroids are widely used due to their anti-inflammatory properties, which can reduce itching and inflammation associated with PCD.<sup>[35]</sup> The potency of the corticosteroid should be tailored to the severity of the symptoms and the skin area being treated, with milder formulations recommended for sensitive areas such as the face.<sup>[16]</sup> Topical corticosteroid ointments versus creams are recommended for patients with a history of atopic dermatitis or contact dermatitis due to the presence of preservatives in steroid creams.<sup>[7]</sup> Calcineurin inhibitors, such as tacrolimus and pimecrolimus, offer an alternative for patients where corticosteroids are contraindicated or in cases of long-term management to

avoid corticosteroid-induced skin atrophy.<sup>[26]</sup> These agents have demonstrated effectiveness in reducing inflammation while having a lower risk of adverse effects. Additional topical agents, including skin-lightening creams containing hydroquinone, may be used judiciously to address hyperpigmentation, though their use should be closely monitored due to potential side effects.<sup>[3,22]</sup>

In cases where topical treatments are insufficient or in severe widespread PCD, systemic therapies may be considered. Systemic corticosteroids can provide rapid relief in acute, severe cases but are not suitable for long-term control due to the risk of systemic side effects.<sup>[35]</sup> Other systemic treatments, such as cyclosporine, methotrexate, azathioprine, mycophenolate mofetil, and tranexamic acid, have been explored in refractory cases, showing promise in reducing symptoms and improving quality of life.<sup>[26,36,40-42]</sup> However, their use requires careful consideration of the potential risks and benefits, and monitoring for adverse effects is essential.<sup>[36]</sup>

Equipping patients with the knowledge to manage their condition is fundamental. This includes educating patients on the importance of trigger avoidance, proper skincare routines, and the appropriate use of topical treatments. Lifestyle modifications, such as wearing protective clothing and gloves when handling potential irritants and choosing fragrance-free, hypoallergenic products, can also significantly reduce the risk of exacerbations.<sup>[37]</sup> Vigilant sun protection including sunscreen is also important for this. Patient education has been shown to improve treatment adherence and outcomes, highlighting its critical role in the comprehensive management of PCD.<sup>[36]</sup>

### **3.5 EMERGING RESEARCH AND FUTURE DIRECTIONS**

As the understanding of PCD evolves, so does the pursuit of innovative treatment strategies and preventive measures. Emerging research in the field is paving the way for novel therapies, underscoring the importance of public health strategies and highlighting the need for further study to address existing gaps in knowledge. Recent advancements in the treatment of PCD have focused on the development of novel therapeutic agents and modalities. Biologic therapies targeting specific immune pathways implicated in the pathogenesis of contact dermatitis are currently under investigation, with preliminary studies showing promise in reducing inflammation and pigmentation associated with PCD.<sup>[36]</sup> Certain biologics such as dupilumab and omalizumab have been shown to be valuable in the treatment of contact dermatitis.<sup>[43]</sup> Additionally, the use of laser and light-based therapies has been explored for their potential to improve hyperpigmentation, offering a noninvasive option for patients with persistent lesions.<sup>[3,6]</sup> Intense pulse light (IPL), widely utilized to treat various pigment disorders, has successfully treated hyperpigmentation in a few cases of PCD by converting light energy to heat energy, as it directly targets, and removes melanin in the epidermis.<sup>[13,44]</sup> 1064 nm Q-switched Nd:YAG laser has been extensively and safely used to treat chronic hyperpigmentation in all skin types by targeting and destroying melanin pigment within melanophages, though more studies are needed in the specific treatment of PCD, as the pigment may often reside deeper than other pigmentary disorders, necessitating a higher fluence modality.<sup>[13]</sup> The 755 nm picosecond Alexandrite laser has become a popular and effective way to remove unwanted skin discoloration due to its ability to more selectively target and destroy melanosomes without causing excess thermal damage to surrounding tissue (selective photo thermolysis).<sup>[13]</sup> However, while few case reports show promise in treating PCD, more studies are needed specifically in skin of color as adverse effects such as



dyspigmentation and scarring are still associated with its usage as well as other nanosecond Q-switched lasers.<sup>[45]</sup>

In parallel with therapeutic developments, research into preventive strategies for PCD is gaining momentum. Efforts are focused on identifying and regulating common allergens in consumer products, thereby reducing the population's exposure to potential triggers.<sup>[34]</sup> Public health campaigns aimed at raising awareness about the risks associated with certain chemicals and promoting safer product formulations are crucial for preventing PCD.<sup>[38]</sup> Moreover, workplace safety initiatives designed to minimize occupational exposure to irritants have been shown to effectively reduce the incidence of PCD in high-risk industries.<sup>[16,17]</sup>

Despite these advances, significant gaps remain in our understanding of PCD. One such area is the genetic basis of susceptibility to PCD, where research is needed to identify specific genetic markers that may predispose individuals to the condition.<sup>[39]</sup> Additionally, the long-term efficacy and safety of emerging treatments, such as biologic therapies and laser interventions, require further investigation through randomized controlled trials. Another critical area of research involves the development of standardized diagnostic criteria and treatment protocols to ensure consistent and effective management of PCD across different healthcare settings.<sup>[26,36]</sup>

## 4 DISCUSSION

### 4.1 IMPLICATIONS FOR CLINICAL PRACTICE

Understanding the intricate interplay between environmental exposures, individual susceptibility, and direct contact with specific chemical agents is paramount for healthcare providers.<sup>[1,5,6,11]</sup> Identifying fragrances, preservatives, and dyes as primary culprits accentuates the importance of thorough patient history and environmental assessments in effectively managing PCD.<sup>[3,4,15,16]</sup>

In clinical practice, addressing the diagnostic challenges presented by PCD's nonspecific symptoms and its resemblance to other pigmented skin conditions is crucial. The typical presentation of hyperpigmented patches or macules, especially in areas exposed to offending agents, is a critical diagnostic indicator. However, distinguishing PCD from conditions like melasma, PIH, and lichen planus pigmentosus necessitates comprehensive clinical evaluations underpinned by patch testing and, occasionally, histopathology for confirmation in atypical presentations or cases unresponsive to treatment.<sup>[5,14,19-22]</sup>

The management strategy for PCD emphasizes the avoidance of identified triggers, underlining the necessity of extensive patient education about lifestyle adjustments and the selection of suitable personal care products. While topical treatments such as corticosteroids and calcineurin inhibitors form the cornerstone of symptom management, controversies surrounding the long-term steroid use call for a careful and judicious approach.<sup>[16,26,35]</sup> Systemic therapies, though considered for severe cases, underscore the continuous quest for more effective treatment options beyond traditional methods.<sup>[26,36]</sup>

Emerging research into novel therapies, including biologics and laser treatments, indicates a growing field of innovative therapeutic approaches for PCD. Additionally, the focus on preventive measures and public health campaigns to minimize exposure to prevalent allergens represents a forward-thinking strategy to decrease PCD incidence.<sup>[3,6,34,38]</sup> However, acknowledging significant gaps in research, especially in understanding PCD's

genetic aspects and the long-term effectiveness of new treatments, outlines a clear direction for future studies.  
[36,39]

Incorporating these findings into clinical practice requires a comprehensive approach that combines evidence-based management strategies with patient-centric care. Healthcare providers are advised to stay informed about the progressive nature of PCD research to ensure that diagnosis, treatment, and patient education strategies are reflective of the latest scientific evidence and best practices. The evolving understanding of PCD, alongside advancements in dermatological research, highlights the necessity for ongoing education and flexibility in clinical practice to improve patient care for this complex condition.

#### 4.2 CHALLENGES AND CONTROVERSIES

The diagnosis and management of PCD present a series of challenges and controversies within the dermatological community. The primary challenge in diagnosing PCD lies in its nonspecific symptoms and significant overlap with other dermatological conditions, such as melasma, PIH, and lichen planus pigmentosus.  
[6,19,21,31] The heterogeneity in the presentation of PCD, characterized by varying degrees of pigmentation without a distinct pattern of inflammation, often leads to misdiagnosis or delayed diagnosis.<sup>[5,6,22]</sup> Furthermore, the reliance on patient history to identify potential contact allergens or irritants can be problematic due to the insidious nature of exposure and the latency period before symptom manifestation.<sup>[29,30]</sup> The absence of specific biomarkers or diagnostic tests adds another layer of complexity, necessitating a high degree of clinical suspicion and often a multidisciplinary approach to accurately identify PCD.<sup>[26,39]</sup>

The management of PCD is subject to debate, primarily concerning the long-term use of certain medications and the adoption of novel therapies. Topical corticosteroids, while effective in reducing inflammation and pruritus, raise concerns regarding skin atrophy, telangiectasia, and steroid-induced rosacea with prolonged use, particularly on delicate skin areas such as the face.<sup>[6,16,17]</sup> Similarly, the safety and efficacy of skin-lightening agents like hydroquinone have been questioned, given the potential risks of ochronosis and carcinogenicity, leading to restrictions in several countries.<sup>[3,22]</sup>

Emerging therapies, including biologics and laser treatments, while promising, have sparked debate regarding their place in the treatment hierarchy, cost-effectiveness, and long-term safety profile.<sup>[3,6]</sup> The absence of comprehensive guidelines and standardized treatment protocols for PCD complicates these issues, leading to variability in practice and potential under or overtreatment of patients.<sup>[26,36]</sup> Advocates for more conservative management emphasize the importance of trigger avoidance and the use of non-pharmacological interventions as first-line strategies, while others argue for the proactive use of advanced therapies to address the condition more aggressively.<sup>[16,26,35]</sup>

#### 4.3 RECOMMENDATIONS FOR HEALTHCARE PROVIDERS

Healthcare providers play a pivotal role in the accurate identification, effective management, and proactive prevention of this condition. The following recommendations are designed to guide practitioners in navigating the challenges associated with PCD, ensuring patients receive the most informed and compassionate care possible.



The identification of PCD involves three main areas: 1) Maintain a High Index of Suspicion: Given the nonspecific symptoms and overlap with other dermatological conditions, clinicians should consider PCD in the differential diagnosis when patients present with persistent hyperpigmentation, especially in the absence of significant inflammation.<sup>[6,19-21]</sup> 2) Detailed Patient History: Collect comprehensive exposure histories, including occupational, environmental, and personal care product use, to identify potential contact allergens or irritants<sup>[29,30]</sup>. 3) Physical Examination: Conduct thorough skin examinations, noting the distribution, pattern, and color of pigmentation, which can provide clues to PCD. Pay special attention to areas typically exposed to cosmetic or industrial products.<sup>[6,29]</sup>

The management of PCD is accomplished through the avoidance of triggers, topical treatments, and patient education: 1) Avoidance of Triggers: Educate patients on the importance of avoiding known or suspected allergens. This may involve changes in personal care products, workplace modifications, or environmental adjustments.<sup>[16,26,35]</sup> 2) Topical Treatments: Utilize topical corticosteroids for short-term management of inflammation and pruritus, being mindful of the risks associated with prolonged use. For chronic management, consider calcineurin inhibitors as an alternative to reduce the risk of skin atrophy and other steroid-related side effects.<sup>[16,26,35]</sup> 3) Patient Education: Provide patients with information on the chronic nature of PCD and the importance of consistent adherence to avoidance and treatment strategies. Empower patients with knowledge about their condition and the rationale behind treatment recommendations.<sup>[36,37]</sup>

The prevention of PCD is essential: 1) Public and Occupational Health Advocacy: Advocate for safer product formulations and workplace practices to reduce the prevalence of PCD. This includes lobbying for regulations that limit the use of known irritants in consumer and industrial products. 2) Community Education: Engage in community education efforts to raise awareness about PCD, including workshops, informational brochures, and online resources. Educating the public about the risks associated with certain chemicals can lead to more informed choices and potentially reduce the incidence of PCD. 3) Continuing Education for Healthcare Providers: Stay informed about the latest developments in the diagnosis and management of PCD through continuing medical education. This ensures that healthcare providers are equipped with the most current knowledge and tools to care for their patients effectively.

In implementing these recommendations, healthcare providers can significantly impact the identification, management, and prevention of PCD, improving patient outcomes and contributing to a broader understanding of this condition. By adopting a patient-centered approach that emphasizes education, prevention, and evidence-based management strategies, clinicians can navigate the complexities of PCD with confidence and competences.

## 5 CONCLUSION

This integrated review of PCD has highlighted the multifactorial etiology involving environmental exposures, individual susceptibility, and direct contact with chemical irritants, emphasizing fragrances, preservatives, and dyes as significant culprits.<sup>[1,6,10,11]</sup> The clinical presentation, characterized by hyperpigmented patches or macules, poses diagnostic challenges due to symptom overlap with other dermatoses, necessitating a comprehensive approach, including patch testing for accurate diagnosis.<sup>[6,17,19-21]</sup> Management strategies focusing on trigger avoidance, appropriate use of topical treatments, and patient education have been

highlighted as effective, though the need for standardized protocols and further research into novel therapies is evident.<sup>[6,16,17,19-21]</sup>

The clinical relevance of this review underscores the necessity for healthcare professionals to be vigilant in recognizing PCD, implementing precise diagnostic strategies, and adopting multifaceted management plans tailored to individual patient needs. An understanding of how to treat PCD in people of color is important given these needs and the impact of the properties of the exposing agent, the nature and duration of skin contact, and the affected patient's susceptibility to the condition.<sup>[9]</sup> Moreover, the call for further research in under-explored areas, particularly the genetic underpinnings of PCD and the development of new therapeutic modalities, is critical for advancing care.

In conclusion, enhancing awareness and education about PCD among healthcare professionals and patients is paramount. As the landscape of contact dermatitis continues to evolve, a concerted effort towards understanding the complexities of PCD, fostering patient-centered care, and pursuing innovative research will be pivotal in improving outcomes for those affected by this challenging condition.

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