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Developing Guidelines for Differentiating Non-Accidental Trauma from Chronic Skin Conditions through the Intersection of Pediatric Dermatology and Child Protective Services

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ABSTRACT

Accurately distinguishing non-accidental trauma (NAT) from chronic dermatologic conditions in pediatric patients remains a challenge requiring an interdisciplinary approach. Many skin disorders—including phytophotodermatitis, coagulopathies, atopic dermatitis, epidermolysis bullosa (EB), vasculitis/vasculopathy, and genetic skin fragility disorders—can present with bruise-like lesions, burns, erosions, or excoriations, closely resembling signs of inflicted injury. The absence of standardized dermatologic criteria in forensic evaluations increases the risk of both misdiagnosis and unnecessary child protective interventions, particularly in children with skin of color, where post-inflammatory pigmentary changes and resolving dermatoses can be misinterpreted as abuse-related trauma. Establishing evidence-based guidelines to differentiate dermatologic mimickers from inflicted injuries requires a structured approach incorporating pattern recognition, lesion morphology, anatomical distribution, and adjunctive diagnostic testing. Key distinguishing features include the presence of koebnerization, symmetric versus asymmetric lesion distribution, the timing of lesion evolution (synchronous vs. asynchronous healing), histopathologic correlates, and associated systemic findings. Advanced diagnostic tools such as dermoscopy, polarized light examination, and targeted laboratory and genetic testing can provide additional clarity

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in ambiguous cases. Strengthening collaboration between pediatric dermatologists, forensic specialists, social workers, and child protection teams have the potential to refine forensic assessments and ensure accurate evaluations that balance patient welfare with parental rights. Implementing standardized dermatologic evaluation protocols within child protective services has the potential to reduce misdiagnosis, minimize unnecessary family separation, and ensure that true cases of maltreatment receive appropriate intervention. Integrating dermatologic expertise into forensic frameworks allows for a more precise and equitable approach to evaluating pediatric cutaneous findings.

Keywords: Pediatric Dermatologists, Skin Tones, Forensic Investigations, Allergic, Pediatric Patients

INTRODUCTION

Distinguishing between pediatric dermatologic conditions and non-accidental trauma (NAT) is a critical yet complex task in clinical practice. Many chronic or genetic skin disorders, such as atopic dermatitis, epidermolysis bullosa, coagulopathies, and vasculitis/vasculopathy, can present with skin findings that closely resemble physical abuse, including bruising, burns, excoriations, and erosions. This is particularly significant given that the skin is the most common organ involved in cases of nonaccidental injury [1], with up to 90% of physically abused victims exhibiting cutaneous findings [2,3]. This clinical overlap poses a significant diagnostic dilemma for healthcare providers, particularly when dermatologic expertise is not integrated early into the initial evaluation process.

Accurate differentiation between NAT and its mimickers is critical to ensuring timely intervention for children who are victims of abuse, while simultaneously preventing unwarranted child protective investigations and potential family separation in cases of benign dermatologic conditions. A recent review by Ricciardo et al. [4] highlights the prevalence and clinical features of common pediatric dermatologic conditions—including impetigo, scabies, head lice, tinea, atopic dermatitis, and acne—in children with skin of color. The authors emphasize the pivotal role of pediatricians in correctly identifying these conditions to mitigate misdiagnosis and prevent downstream consequences, such as the inappropriate involvement of child protective services and the misallocation of resources intended for genuine cases of maltreatment. This diagnostic concern is further illustrated in a systematic review by King et al. [5], which found that among 29 cases referred to child protective services, a majority were ultimately diagnosed with non-abuse-related dermatologic conditions, including irritant contact dermatitis (53.8%), phytophotodermatitis (30.8%), and allergic contact dermatitis (7.7%). Such misinterpretations are especially concerning in children with skin of color, where healing lesions or post-inflammatory pigmentary changes may be mistaken for inflicted injuries due to a limited understanding of dermatologic variation across diverse skin tones.

This review aims to delineate key clinical features that distinguish common pediatric dermatologic conditions from inflicted trauma, identify current gaps in standardized forensic dermatology protocols, and propose evidence-based strategies for interdisciplinary collaboration. Emphasis is placed on improved diagnostic tools, pattern recognition, and standardized assessment protocols to reduce misdiagnosis, minimize bias, and promote equitable care in child protection settings.

REVIEW

Challenges in differentiating dermatitis from NAT

Distinguishing dermatologic conditions from non-accidental trauma (NAT) remains a nuanced and consequential challenge in pediatric evaluation. A wide array of benign inflammatory dermatoses, including phytophotodermatitis, allergic contact dermatitis, and irritant contact dermatitis, can closely mimic inflicted injuries due to overlapping morphologic features and distribution patterns that coincide with high-suspicion anatomical sites. Moreover, the variable timing of lesion onset and progression can further complicate diagnostic clarity. Together, this leads to diagnostic uncertainty, unnecessary reporting to child protective services, or, conversely, missed opportunities to identify true abuse. Thorough history-taking, pattern recognition, and familiarity with common mimickers are critical in forming an accurate diagnosis and protecting child welfare.

Phytophotodermatitis

Phytophotodermatitis exemplifies a particularly deceptive mimicker of NAT due to its polymorphic appearance and irregular distribution. This phototoxic reaction occurs following skin contact with furocoumarin-containing substances—commonly found in limes, celery, and parsley—followed by exposure to ultraviolet A (UVA) radiation [6]. The resulting inflammatory cascade produces erythema, edema,

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vesiculation, and in some cases, blistering and erosion [7]. Lesions frequently present in bizarre, linear, or splash-like patterns on exposed areas, including the face, extremities, or trunk, regions that are also commonly affected in cases of inflicted injury [8]. A hallmark latent period of 24 to 72 hours between exposure and clinical manifestation further complicates timely recognition, especially when caregivers are unaware of the inciting event. The abrupt, spontaneous onset of erythematous or blistering lesions in a child may prompt suspicion of inflicted burns or intentional harm, prompting potentially avoidable forensic investigations.

Contact Dermatitis

Irritant and allergic contact dermatitis similarly pose diagnostic challenges for suspected NAT. These conditions typically present with pruritic, erythematous, vesicular, or crusted lesions, all of which are features that may be mistaken for abrasions, thermal injuries, or repetitive trauma [9]. In pediatric patients, common sources of contact dermatitis include fragrances, preservatives, and materials used in diapers and personal care products, with lesions typically localized to areas of direct contact [10]. Without proper dermatologic input, these localized inflammatory reactions can be misconstrued as suspicious injuries, leading to delays in appropriate treatment and escalating unwarranted protective interventions.

Atopic Dermatitis

Atopic dermatitis, a chronic and relapsing inflammatory skin disease, further complicates diagnostic interpretation due to its diverse clinical manifestations. Children with poorly controlled disease often exhibit widespread excoriations, erosions, and secondary bacterial infections due to persistent scratching, creating cutaneous patterns that may be mistaken for inflicted or repetitive injury [11]. In children with skin of color, diagnostic accuracy is further hindered by differences in disease presentation: erythema may be subtle or absent, and post-inflammatory hyperpigmentation may closely resemble ecchymoses or bruises [12]. These pigmentary changes can persist for weeks to months, even after resolution of the underlying inflammatory process, falsely suggesting ongoing or historical trauma. Compounding this issue is the lack of standardized training on dermatologic variation across skin tones and the underrepresentation of diverse imagery in medical education, which has been shown to perpetuate misdiagnosis and contribute to racial disparities in the evaluation of suspected abuse [13]. To mitigate these risks, clinicians must be equipped with the knowledge and tools to recognize diverse presentations of atopic dermatitis and distinguish them from signs of maltreatment, particularly in children with skin of color.

Epidermolysis Bullosa

In genetic disorders like epidermolysis bullosa (EB), the skin's fragility and propensity to form blisters following minimal trauma or friction can lead to lesions that may be misidentified as abuse-related burns or abrasions [14]. The distribution of these lesions, often localized to pressure-prone areas such as the hands, feet, and buttocks, along with a history of recurrent blistering, may aid in distinguishing EB from suspected abuse [15]. This distinction is critical, as certain physical features of burns, such as symmetric distribution, involvement of the perineum or buttocks, burns that appear older than reported, lack of splash marks, and sharply demarcated outlines, can raise suspicion for NAT [16,17]. In accidental burns, splash marks are commonly present as the child instinctively pulls away from the painful stimulus, whereas intentional burns often lack these patterns due to restraint during injury [18]. In contrast, EB lesions may present with similar morphological features but occur in the absence of trauma or under minimal mechanical stress. Furthermore, a family history of similar conditions and genetic testing can provide additional diagnostic clues.

Coagulopathies and Vasculitides

Hemorrhagic lesions such as petechiae and ecchymoses may arise spontaneously in pediatric patients with underlying hematologic or inflammatory disorders and can mimic the appearance of abuse-related injuries. These purpuric lesions often involve sites commonly scrutinized in cases of suspected maltreatment, including the extremities and torso [19]. Coagulopathies—such as hemophilia, von Willebrand disease, or thrombocytopenia—can lead to spontaneous bruising or bleeding due to impaired clotting mechanisms. Similarly, small vessel vasculitides like Henoch-Schönlein purpura may present with palpable purpura and systemic symptoms, such as fever, abdominal pain, arthralgia, or hematuria, features that aid in distinguishing them from trauma-induced lesions [20]. A comprehensive clinical history, including previous episodes of unexplained bleeding, family history of bleeding disorders, and medication use, is essential in evaluating these findings. In the absence of such historical or clinical

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indicators, differentiating between coagulopathy, vasculitis, and trauma-related lesions can be challenging. Laboratory investigations, including complete blood counts, coagulation profiles, inflammatory markers, and serologic testing for autoantibodies, are critical in confirming the diagnosis and preventing misinterpretation of medical conditions as signs of physical abuse [21]. Ultimately, the integration of clinical, historical, and laboratory data in EB is essential to ensure accurate diagnosis and appropriately manage the underlying medical conditions.

Chronic Dermatoses and Atypical Healing Patterns

In chronic or relapsing dermatoses, the natural course of lesion evolution may deviate from expected healing trajectories, further complicating the diagnostic picture. Recurrence, scratching, secondary infection, and delayed resolution due to inappropriate management can yield atypical morphologies, prompting suspicion for mistreatment, particularly by clinicians lacking specific dermatologic training [22]. Features such as the absence of synchronous healing and the variability in lesion morphology and distribution can heighten clinical concern. These findings often reflect the natural course of the underlying chronic dermatologic condition.

Ultimately, these diagnostic complexities underscore the critical need to integrate dermatologic expertise into multidisciplinary evaluations of suspected NAT. Clinicians must maintain a high index of suspicion for both inflicted injury and potential mimickers, especially in vulnerable populations. The implementation of standardized dermatologic assessment protocols, improved clinician education on diverse skin presentations, and interdisciplinary collaboration are essential steps toward reducing diagnostic error and promoting equitable, evidence-based care.

KEY DIAGNOSTIC FEATURES TO DIFFERENTIATE DERMATITIS FROM NAT

History and Clinical Context

The proper differentiation between dermatitis and non-accidental trauma (NAT) begins with a detailed, nonjudgmental clinical history. Eliciting a timeline of events, both those leading up to the current presenting episode and past episodes, can uncover recurring dermatologic episodes or expose inconsistencies that prompt suspicion for abuse. Additionally, the history should target key dermatologic clues, including exposure to irritants or allergens such as soaps, detergents, or environmental allergens. A personal or family history may further prove helpful, as conditions like atopic dermatitis have genetic components [23]. In contrast, certain historical elements are more suggestive of NAT, including vague or conflicting caregiver accounts, delay in seeking medical attention, absence of common at-home treatments, or recurrent unexplained injuries, particularly in the child or across multiple children in the same home. Observational subtle behaviors during the interview, such as itching or self-soothing when unobserved, may also suggest dermatologic dermatoses rather than inflicted trauma [24]. Taken together, these contextual nuances can help clinicians build a more accurate clinical picture, guiding appropriate next steps while minimizing the risk of misdiagnosis and unnecessary intervention.

Physical Exam Patterns

A thorough physical examination is also essential in guiding the diagnostic process. Dermatitis frequently presents as symmetric, pruritic lesions, commonly localized to the flexural surfaces. In contrast, NAT typically presents with asymmetrical lesions with varying morphology and healing stages. Injuries located in non-ambulatory or anatomically protected areas such as the posterior trunk, upper arms, inner thighs, or back should raise concern for abuse, as these are uncommon locations for dermatologic lesions due to natural childhood activity [25]. Recognizing these distribution patterns can help clinicians distinguish between benign dermatologic conditions and potentially abusive injuries. When physical exam findings are coupled with a detailed history and consideration of developmental capabilities, they become critical tools in assessing the likelihood of NAT.

Certain exam features also offer diagnostic specificity. For instance, the presence of koebnerization, or new lesion development along sites of repeated mechanical irritation, points toward an endogenous dermatologic condition rather than trauma [26]. In contrast, NAT often results in asymmetric patterns, inconsistent lesion stages, and location-specific findings uncharacteristic of typical dermatoses [27,5]. Recognizing these anatomic and distribution patterns is critical for interpreting physical findings in the context of the child's broader clinical story.

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Lesion Chronology and Evolution

Beyond distribution, the temporal evolution of lesions further aids in diagnosis. Inflammatory conditions or dermatitis typically present with lesions at similar stages of evolution, corresponding to acute flares or chronic changes in response to known triggers. NAT, however, frequently manifests with lesions at various stages of healing, suggesting repetitive injury over time [28]. Discrete attention should be paid to key physical exam features such as lesion size, pigmentation or coloring (especially in bruising and stretch marks), distribution, and configuration concerning anatomic placement. These features, when interpreted in the broader clinical context, can help distinguish natural dermatologic disease progression from inflicted trauma, informing whether additional investigation or reporting is warranted.

Adjunctive Diagnostic Tools: Histopathology and Dermoscopy

When the history and physical examination remain inconclusive, histopathologic analysis can offer additional diagnostic clarity. Traumatic lesions typically show dermal hemorrhage, adipocyte necrosis, and erythrocyte extravasation with associated inflammatory infiltrates. In contrast, inflammatory dermatoses often demonstrate spongiosis, epidermal hyperplasia, and superficial perivascular lymphocytic infiltrates [29,30]. However, despite its diagnostic utility, the invasive nature of biopsy, particularly in pediatric populations, often necessitates a more conservative approach.

In this context, dermoscopy has emerged as a valuable, non-invasive adjunct. Inflammatory dermatoses often display features such as dotted vessels in patchy distributions and yellow scaling [31,32], while traumatic lesions (including those from NAT) exhibit red-black homogenous pigmentation with satellite globules features [33]. By enhancing the visualization of pigmentary alterations, polarized light dermoscopy can further enhance diagnostic precision by distinguishing post-inflammatory hyperpigmentation from contusions [34]. This is particularly useful in children with skin of color, where pigmentation changes can obscure visual assessments of underlying pathology. When integrated with detailed history-taking and pattern recognition on physical exam, these non-invasive diagnostic tools significantly improve diagnostic certainty and reduce the need for unnecessary invasive procedures, ensuring both the medical safety and legal protection of their pediatric patients.

INTERDISCIPLINARY COLLABORATION AND APPLICATIONS

Need for Multidisciplinary Evaluation

While cutaneous findings are among the most common indicators of non-accidental trauma (NAT), many dermatologic conditions can closely mimic signs of NAT. Differentiating between the two poses a diagnostic challenge, as failure to accurately recognize these mimickers may result in misdiagnosis and unwarranted suspicion of maltreatment. A thorough, evidence-based evaluation benefits from the coordinated expertise of pediatric dermatologists, Child Protective Services (CPS), social workers, and forensic medical specialists. This interdisciplinary model enhances diagnostic accuracy, reduces implicit bias, and prioritizes child safety.

Role of Pediatric Dermatologist

Pediatric dermatologists play a central role in distinguishing benign cutaneous findings of dermatologic conditions from NAT. Unlike primary care providers or emergency clinicians, who may have limited exposure to complex or subtle dermatologic patterns, resulting in potential misclassification of benign findings as suspicious, dermatologists can recognize the chronicity, distribution, and morphologic clues associated with specific skin conditions [35]. Common mimickers of NAT include Mongolian spots, urticaria pigmentosa, epidermolysis bullosa, phytophotodermatitis, and lichen sclerosus [36]. Although these conditions are generally benign, some have been misinterpreted as signs of NAT. For example, a study of 72 girls with early-onset lichen sclerosus revealed that sexual abuse was frequently considered [37], and another review confirmed abuse in 12 of the 42 patients with diagnosed lichen sclerosus et atrophicus [38]. These findings emphasize the importance of expert dermatologic input in evaluating ambiguous cases and suspected mimicker dermatoses. Key historical details, such as congenital onset, family history of similar findings, and short-interval follow-up, can further clarify the diagnosis without the need for invasive intervention [36,8]. Early dermatology consultation in suspected cases of NAT is critical to ensuring diagnostic precision and preventing inappropriate labeling.

Role of CPS and Social Work

CPS, social workers, and other professionals are essential in managing suspected NAT, especially when safety concerns extend beyond the immediate clinical setting. Consultations

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with Child Abuse Pediatrics (CAP) specialists have been shown to decrease unnecessary CPS reports by providing expert contextual interpretation of clinical findings [39]. However, dermatologic expertise remains crucial, particularly in children with skin of color, whose skin conditions may be less familiar to general practitioners. A recent multicenter study found that Black children and adolescents were disproportionately suspected of experiencing abuse compared to other racial groups [40]. These findings illustrate how racial disparities across medical, legal, and social institutions can lead to misjudgment and potential harm to marginalized families [41]. To prevent such outcomes, pediatric dermatologists should be integrated early into multidisciplinary discussions. Additionally, CPS and social work teams should be equipped with access to dermatologic input, especially for ambiguous, recurrent, or culturally nuanced skin presentations to avoid premature or inappropriate interventions.

Role of Forensic Evaluation

Forensic medical specialists often assess whether skin findings are indicative of NAT, yet their evaluations may lack standardized dermatologic criteria, contributing to diagnostic variability and bias. A retrospective analysis demonstrated that, in the absence of structured protocols, children with high-risk bruising who were on Medicaid were more likely to be reported to child welfare services [42]. In contrast, when universal abuse screening was implemented at a trauma center, it led to increased detection of suspected abuse among White and privately insured children [43]. These examples highlight how socioeconomic and racial biases may shape forensic assessments, further reinforcing the need for consistent, objective, and standardized pathways in NAT assessments.

Tools to Standardize Evaluation and Reduce Bias

Collaboration with pediatric dermatologists allows for the incorporation of objective features, such as lesion morphology, stage of healing, and presence of diagnostic patterns (e.g., Koebner phenomenon), into forensic evaluation. Standardized diagnostic aids, such as lesion mapping and clinical decision algorithms, can improve the reliability of assessments across clinical and non-clinical teams. For instance, the use of child abuse-specific EMR order sets has improved adherence to American Academy of Pediatrics screening guidelines for suspected NAT cases [44], with replication of adherence across racial and ethnic groups in subsequent studies [45]. Similarly, early integration of child protection and social work teams through clinical pathways has reduced socioeconomic disparities in NAT evaluation [46]. Prediction rules, such as TEN-4-FACESp, further support unbiased, high-sensitivity screening for NAT-related bruising in children under 4 years of age [47]. Together, these tools highlight the critical role of structured, evidence-based, interdisciplinary frameworks in reducing diagnostic uncertainty and inequity in the evaluation of suspected NAT.

Bridging Gaps

To address remaining disparities, interdisciplinary guidelines must be developed to help CPS and related professionals distinguish dermatologic disease from NAT more effectively. As underscored above, implicit biases associated with race and socioeconomic status continue to influence diagnostic decisions. Education tailored to CPS personnel should prioritize cultural competence, implicit bias mitigation, and understanding of dermatologic variation across Fitzpatrick skin types. Guidelines should also clearly define criteria for dermatologic consultation in ambiguous cases. By fostering a collaborative model grounded in dermatologic expertise and cultural sensitivity, CPS professionals will be better prepared to navigate complex cases with improved diagnostic confidence.

RESEARCH GAPS AND FUTURE DIRECTIONS

Gaps in Current Research

Despite increased awareness of dermatologic diversity, significant gaps remain in research focused on distinguishing dermatologic conditions from non-accidental trauma (NAT) in pediatric patients with skin of color. The paucity of data contributes to misinterpretation of benign skin findings, such as post-inflammatory hyperpigmentation or congenital dermal melanocytosis, as signs of abuse, particularly in children from underrepresented racial and ethnic backgrounds [48,49]. These diagnostic errors may prompt unnecessary Child Protective Services (CPS) involvement, family separation, and lasting psychological harm. The underrepresentation of diverse skin tones in clinical image databases and educational resources further hinders diagnostic accuracy, underscoring the urgent need for research specifically addressing NAT mimickers in diverse pediatric populations.

Emerging Diagnostic Technology

Emerging technologies, including artificial intelligence

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(AI), offer promising diagnostic tools to assist clinicians in differentiating benign skin findings from potential abuse. Deep neural networks have demonstrated proficiency in skin cancer detection, performing at a level comparable to dermatologists [50,51]. When trained on racially and ethnically inclusive datasets, these models may enable faster, more objective assessments of dermatologic conditions, particularly in settings with limited access to specialists [52]. However, variability in algorithm performance, as highlighted by Wongvibulsin et al. [53], emphasizes the importance of rigorous clinical validation before integration into routine pediatric care.

One particularly promising innovation is the use of AI-assisted dermoscopy. By enhancing image analysis of skin lesions, AI-integrated dermoscopy tools may help identify subtle morphological differences between traumatic lesions and mimicking conditions, such as phytophotodermatitis or irritant dermatitis linked to cultural practices. Incorporating these tools into clinical workflows, especially when combined with teledermatology, could allow for timely specialist consultation, particularly in resource-limited or rural settings. These technologies must, however, be developed and tested in pediatric populations with diverse skin tones to ensure equitable application.

Clinician Education and Training

While technological advances hold promise, they cannot substitute for comprehensive clinical education and training. Many common dermatologic conditions, such as atopic dermatitis, contact dermatitis, and post-inflammatory changes, present differently in skin of color, which may confuse clinicians unfamiliar with these variations. Additionally, culturally specific practices such as coining, cupping, and moxibustion can produce distinct skin markings that mimic inflicted injuries [54,55]. A culturally sensitive, trauma-informed clinical history is essential to distinguish these practices from abuse. Yet, such training is often lacking in both pediatric and dermatology curricula.

Specialized training programs are needed at every level of care. Pediatricians, dermatologists, emergency physicians, and primary care providers should be equipped to recognize dermatologic mimickers of NAT, especially in diverse populations. Educational efforts should emphasize visual recognition skills, culturally informed interviewing, and multidisciplinary communication. Furthermore, frontline healthcare workers such as nurses and medical assistants, who often conduct initial assessments, should receive training in the identification of both benign and suspicious lesion findings.

Multidisciplinary collaboration is essential to achieving accurate and equitable evaluations. Social workers, CPS personnel, and law enforcement professionals must understand the dermatologic nuances in pediatric populations that can affect the interpretation of pediatric skin findings. Standardized communication protocols, early access to dermatology consultation, and ongoing cross-disciplinary education can reduce misdiagnoses, prevent unnecessary interventions, and promote just outcomes in suspected NAT cases.

CONCLUSION

The clinical overlap between pediatric dermatologic conditions and non-accidental trauma (NAT) presents a complex diagnostic challenge. Common skin disorders such as phytophotodermatitis, atopic dermatitis, and contact dermatitis can closely mimic inflicted injuries like bruises, burns, and abrasions. Misclassification may lead to inappropriate child protective interventions or, conversely, oversight of cases of true abuse. These challenges are especially pronounced in children with skin of color, where pigmentary changes and atypical inflammatory responses are frequently misinterpreted due to limited representation in clinical training and educational resources. Despite visual similarities, careful attention to lesion morphology, distribution, timing, and systemic context can help clinicians differentiate dermatologic conditions from NAT when paired with thorough history-taking, clinical examination, and tools like dermoscopy or histopathology. To reduce diagnostic ambiguity and mitigate bias, a structured, evidence-based approach is urgently needed. This includes the development of inclusive standardized clinical guidelines, culturally competent evaluation frameworks, and interdisciplinary collaboration among pediatric dermatologists, child abuse specialists, forensic experts, and child protection teams. Future research should prioritize the expansion of diverse dermatologic image databases, validation of diagnostic tools, and assessment of emerging technologies like artificial intelligence for clinical utility. Equally important is enhanced education for both healthcare providers and child protective

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services to ensure accurate, equitable, and trauma-informed evaluations that uphold both child safety and family integrity.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

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