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Recognizing Hidden Paraneoplastic Skin Conditions in People with Skin of Color

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Abstract

Background: *Paraneoplastic dermatoses are important early indicators of underlying malignancies, but in patients with skin of color (SOC), these conditions often present with atypical clinical features. This atypical presentation can lead to delayed or missed cancer diagnoses, contributing to poorer outcomes in this population.*

Objective: *This review examines the clinical variability of paraneoplastic skin manifestations in SOC patients, identifies common diagnostic pitfalls, and evaluates emerging diagnostic tools and educational strategies aimed at improving early cancer detection in this underserved group.*

Methods: *A narrative synthesis was conducted on peer-reviewed literature published between 2015 and 2025 from PubMed-indexed dermatology and oncology journals. The search emphasized studies involving Fitzpatrick skin types IV–VI, with particular focus on dermoscopy, histopathology, and disparities in dermatology education and training.*

Results: *Key paraneoplastic dermatoses, including dermatomyositis, acanthosis nigricans, lichenoid eruptions, and pigmented basal cell carcinoma, frequently exhibit altered clinical and dermoscopic features in SOC patients, which complicates timely recognition. Advances in diagnostic technologies such as multispectral imaging and AI-enhanced dermoscopy demonstrate promising potential in addressing these diagnostic challenges. Additionally, the lack of representation of SOC in educational resources remains a significant barrier to equitable care.*

Conclusion: *Improving oncologic outcomes in SOC requires a multifaceted approach that integrates pigment-sensitive diagnostic criteria, enhanced educational inclusivity, and the adoption of innovative imaging technologies. Such strategies are essential to close existing diagnostic gaps and ensure equitable, timely cancer care for patients with skin of color.*

Keywords: *skin of color, paraneoplastic dermatoses, dermatomyositis, basal cell carcinoma, dermoscopy, diagnostic disparities, health equity*

1. Introduction

Paraneoplastic syndromes represent a critical intersection between dermatology and oncology, where cutaneous manifestations often precede or coincide with internal malignancies and provide a valuable opportunity for early cancer detection. These conditions,which include dermatomyositis and acanthosis nigricans, arise from tumor-secreted cytokines or cross-reactive immune responses, with up to 25% of cases signaling hidden cancers [2]. Classic signs, such as the violaceous heliotrope rash of dermatomyositis or the velvety plaques characteristic of malignant acanthosis nigricans, have been well described in fair-skinned populations and form the foundation of current diagnostic criteria [19, 29].

However, an overreliance on these "textbook" features overlooks the biological variation introduced by skin pigmentation, placing patients with skin of color (SOC) at greater risk of missed or

delayed diagnosis. This disparity has important clinical consequences. Paraneoplastic dermatoses in SOC are not inherently less common but are frequently underrecognized due to pigment-related changes in lesion appearance [28]. As a result, diagnostic delays contribute to more advanced-stage cancer presentations, with evidence showing that SOC patients are more than twice as likely to present with metastatic disease when paraneoplastic skin signs are missed [9].

The reasons for diagnostic delay in SOC patients are both biological and systemic. Melanin's masking effect can obscure signs such as erythema and vascular changes, which alters the presentation of inflammatory dermatoses. For example, dermatomyositis-associated Gottron's papules often appear as hyperpigmented macules rather than the typical erythematous plaques in SOC [18]. Adding to this challenge is a profound representation gap in dermatology education: only 9.7% of images in standard textbooks depict conditions on darker skin, and two-thirds of dermatology trainees report insufficient training specific to SOC [1, 26]. This lack of exposure perpetuates diagnostic errors, with clinicians sometimes mistaking malignant acanthosis nigricans for benign hyperpigmentation or confusing pigmented basal cell carcinoma with nevi [11, 7]. These errors carry serious oncologic implications. For instance, delayed diagnosis of dermatomyositis in SOC patients has been linked to a 40% greater chance of presenting with advanced ovarian cancer [28]. Together, these disparities highlight the urgent need for diagnostic tools and education that address the nuances of pigment-modified skin disease.

This review focuses on four paraneoplastic dermatoses where presentations in SOC most commonly evade recognition: dermatomyositis, acanthosis nigricans, lichenoid eruptions, and pigmented basal cell carcinoma. We synthesize current evidence on pigment-modified features, such as the gray-brown mucosal patches seen in paraneoplastic pemphigus compared to the classic violaceous erosions [6]. Additionally, we evaluate emerging technologies that show promise in bridging diagnostic gaps. Multispectral imaging, for example, improves detection of inflammation that melanin typically obscures, while artificial intelligence-powered dermoscopy increases accuracy in classifying pigmented lesions when trained on diverse datasets [20, 15]. Importantly, we propose actionable strategies, including integrating SOC-specific diagnostic criteria into oncology guidelines and mandating dermatologic consultation for SOC patients with suspected paraneoplastic syndromes. By highlighting these clinical, technological, and educational interventions, this review aims to equip clinicians with the tools necessary to identify early malignancy-associated skin signs across all skin tones and ultimately reduce disparities in cancer outcomes.

2. METHOD

This narrative review synthesized evidence from 29 peer-reviewed articles selected from an initial PubMed pool of 105 studies (January 2015-June 2025), using a search strategy optimized for paraneoplastic dermatoses in skin of color (SOC). Keywords combined three conceptual clusters: (1) SOC terms ("Fitzpatrick IV-VI," "melanin-rich skin"), (2) paraneoplastic conditions ("dermatomyositis," "malignant acanthosis nigricans"), and (3) diagnostic modalities ("dermoscopy," "multispectral imaging") (MeSH terms: Paraneoplastic Syndromes/diagnosis, Skin Pigmentation). The 10-year timeframe captured pivotal advances in SOC dermatology, including AI-powered dermoscopy [15] and updated AAD guidelines on pigment-modified diagnostic criteria [1]. To minimize selection bias, two independent reviewers screened titles/abstracts using Covidence software, with conflicts resolved by a third arbitrator.

2.1. Inclusion/Exclusion Criteria

Studies were included if they: (1) focused on Fitzpatrick skin types IV-VI, (2) reported primary data on clinical presentation, diagnostic accuracy, or educational gaps in paraneoplastic dermatoses, and (3) provided full-text English access [14]. Exclusion criteria eliminated: (1) case reports with <5 patients, (2) studies without histopathologic confirmation of diagnoses, and (3) articles using non-standardized diagnostic criteria (e.g., clinical photos without dermoscopic correlation). Notably, 32 studies were excluded for inadequate SOC representation (e.g., <20% Fitzpatrick IV-VI cohorts), ensuring focus on pigment-specific findings [5].

2.2. Data Extraction and Synthesis

Included studies (n=20) were categorized into four clinically relevant groups:

- Dermatomyositis: Analyzed for SOC-specific rash morphology (e.g., gray-brown heliotrope) and diagnostic delays [28]
- Acanthosis Nigricans: Evaluated malignant vs. benign features using dermoscopic criteria (ridge-dome pattern: 87% PPV for malignancy) [29]

- Lichenoid Eruptions: Assessed histopathologic differentiation of paraneoplastic pemphigus vs. discoid lupus in SOC [21]
- Pigmented BCC: Compared dermoscopic accuracy across skin types (68% misdiagnosis rate in SOC) [11]

Thematic analysis employed NVivo 12 to identify cross-cutting patterns: (1) melanin's masking effect on erythema, (2) underrepresentation in educational resources, and (3) technology gaps in SOC diagnostics. Quantitative data (e.g., diagnostic delay intervals) were tabulated for comparative analysis where available.

Methodological Rationale: A narrative review design was selected over systematic review/meta-analysis due to heterogeneous study designs (observational cohorts, diagnostic accuracy studies) and the need for qualitative synthesis of educational disparities (Murphy, 2012). This approach enabled integration of:

- Clinical data (e.g., SOC-specific dermoscopic patterns)
- Technological innovations (AI sensitivity in SOC populations)
- Educational research (textbook image audits)

2.3. Diagnostic Delays and Misclassification in Paraneoplastic Dermatoses among SOC Populations

Patients with skin of color (SOC) experience significant disparities in the timely and accurate diagnosis of paraneoplastic dermatoses, with delays contributing directly to more advanced cancer stages and poorer outcomes. Weisleder et al. [28] quantified this gap, showing that SOC patients waited an average of 19 days for a dermatomyositis diagnosis - more than twice the 8-day average seen in lighter-skinned patients ($p < 0.05$). This delay is especially concerning given that 20% of adult dermatomyositis cases are paraneoplastic [19]. Misclassification is also common. Nearly 42% of SOC patients with malignancy-associated skin lesions are initially diagnosed with benign conditions such as eczema or tinea, which delays referrals for oncology evaluation [28]. The problem is particularly pronounced for pigmented basal cell carcinoma (BCC), the lesion most frequently misdiagnosed in SOC populations. Studies report that 68% of pigmented BCC cases in SOC are mistaken for nevi or hyperpigmentation due to subtle or absent dermoscopic features [3, 11]. Unlike the translucent nodules and characteristic arborizing vessels typically seen in fair skin, BCC in SOC often presents as subtle blue-gray ovoid nests that are difficult to recognize without training specific to pigmented skin [11]. Adding to this challenge, inflammatory signs such as erythema critical for diagnosing paraneoplastic dermatoses like dermatomyositis or necrolytic migratory erythema, are visually masked by melanin, making standard diagnostic criteria less reliable in SOC patients [18]. These systemic shortcomings highlight the urgent need for targeted interventions, including the development of SOC-specific dermoscopic algorithms and mandatory dermatopathology consultations for ambiguous pigmented lesions in high-risk individuals. Without such measures, SOC populations will continue to face preventable delays in cancer diagnosis and treatment, perpetuating inequities driven by diagnostic invisibility.

2.4. Dermatomyositis: The Disguised Erythema

In patients with skin of color, classic signs of dermatomyositis often present differently, leading to delayed diagnosis and treatment. Take the heliotrope rash, a well-known marker of dermatomyositis. Instead of the textbook purple hue, it might look more like a grayish or dark discoloration around the eyes [18]. Gottron's papules, another key sign, don't appear pink or red; they're often brown and rough instead. In highly pigmented skin, inflammatory signs like erythema are often muted or altered, making them harder to detect. These variations are easy to miss if a clinician isn't used to seeing them in darker skin tones. And missing them matters. Requena et al. [19] conducted a retrospective study of 25 paraneoplastic dermatomyositis (DM) patients from 2004 to 2022, identifying that 20% of DM cases were paraneoplastic and that these patients primarily presented with periungual involvement—such as erythema, inflammation, and necrosis as major diagnostic criteria. Because these periungual signs, such as erythema and necrosis, may not be visually perceived as abnormal on darker skin, they are more likely to be dismissed and misinterpreted. This diagnostic oversight not only delays recognition but also reduces treatment effectiveness due to the faster progression of the disease.

But it's not just about waiting longer, it's about being dismissed. Almost half of patients with skin of color are initially told their symptoms are something minor, like eczema or a simple infection. Meanwhile, more serious diseases continue to grow undetected. A good example is

clinically amyopathic dermatomyositis (CADM). It presents with itchy rashes but no muscle weakness, so it slips under the radar. What's dangerous is that around 1 in 10 CADM cases are tied to hidden cancers, especially ovarian and stomach cancers [2]. If you miss that connection early, you're already behind. These are more than diagnostic errors; they represent blind spots in clinical training and visual pattern recognition, particularly for patients with darker skin. These are missed chances to catch cancer before it is too late.

2.5. Acanthosis Nigricans: The Malignancy Masquerade

Acanthosis nigricans (AN) presents a critical diagnostic dichotomy, where benign metabolic-associated cases must be distinguished from malignant forms signaling occult gastrointestinal malignancies, particularly gastric adenocarcinoma [27]. Malignant AN demonstrates distinct clinical features, including rapid progression, mucosal involvement (oral/labial lesions), and "tripe palms"—a pathognomonic thickening and rugose texture of palmar skin [7]. These findings carry heightened significance in skin of color (SOC) populations, where hyperpigmentation may obscure early malignant changes, leading to an average 6-week diagnostic delay compared to lighter-skinned patients [29]. Dermoscopy emerges as a vital tool for early detection, with the ridge-dome pattern showing 92% specificity for malignancy in SOC patients, versus milia-like cysts which demonstrate variable presence (58-68% sensitivity) and should not rule out cancer when absent [29,17]. The diagnostic challenge is compounded by melanin's masking effect: in SOC patients, malignant AN's characteristic hyperpigmentation often blends with baseline skin tone, while erythematous components—key to recognizing inflammatory malignant transformations—become imperceptible [22]. This underscores the need for a standardized diagnostic protocol incorporating: (1) mandatory oral cavity examination for mucosal lesions, (2) dermoscopic evaluation for ridge-dome patterns, and (3) low-threshold biopsy of acral lesions in high-risk SOC patients (BMI <30, no insulin resistance) [7,1]. Such measures could reduce the current 43% misdiagnosis rate of malignant AN as benign hyperpigmentation in SOC populations, preventing delayed cancer detection [29].

2.6. Lichenoid Eruptions: Camouflaged Color Spectrum

In SOC, paraneoplastic lichenoid lesions and discoid lupus erythematosus (DLE) often deviate from classic textbook appearances, with muted gray-brown pigmentation replacing the hallmark violaceous hue seen in lighter skin tones [6,16,21]. This pigment masking increases diagnostic difficulty, contributing to frequent misclassification as post-inflammatory hyperpigmentation, fixed drug eruption, or pigmented contact dermatitis [12,22]. A 2024 retrospective analysis found that 59% of SOC patients with paraneoplastic pemphigus were initially misdiagnosed, illustrating the dangers of relying on visual cues alone [6]. In DLE, racial differences in lesion characteristics further complicate recognition. Black patients are significantly more likely than non-Black patients to present with dyspigmentation in any location (99% vs. 79%), scalp dyspigmentation (82% vs. 48%), ear dyspigmentation (56% vs. 35%), and scarring alopecia (79% vs. 56%) [25]. Direct immunofluorescence (DIF) remains critical for differentiating overlapping lichenoid disorders, revealing linear IgG and C3 deposition at the epithelial junction in paraneoplastic pemphigus versus granular IgM at the dermoepidermal junction in mucosal lupus erythematosus [21,12]. These immunopathologic patterns are especially important in SOC, where pigment differences obscure erythema, scale, or vesiculation [16,21]. Early biopsy and clinicopathologic correlation are therefore essential to prevent delayed recognition of potentially life-threatening paraneoplastic disease or disfiguring scarring alopecia in DLE [25,21].

2.7. Pigmented Basal Cell Carcinoma (BCC): A Diagnostic Deceiver

Pigmented basal cell carcinoma (BCC) poses unique diagnostic challenges in skin of color (SOC) populations, where classic features like arborizing telangiectasia are often obscured by melanin, occurring in only 32% of SOC cases versus 89% in Fitzpatrick I-III patients [11,4]. Dermoscopy reveals pigment-dominant patterns in SOC, including blue-gray ovoid nests (82% sensitivity) and leaf-like areas (64% specificity), which overlap visually with benign nevi and lentigines [3,23]. This morphologic ambiguity contributes to a 68% initial misdiagnosis rate in SOC patients, compared to 22% in lighter skin tones, as demonstrated in a 2023 multicenter trial of 347 pigmented BCC cases [11]. Diagnostic delays have measurable consequences: SOC patients present with tumors averaging 8.2 mm larger than non-SOC counterparts, requiring 2.3-fold wider surgical margins and correlating with 40% higher recurrence rates [23,1]. The clinical impact is particularly pronounced in facial

lesions, where delayed detection leads to complex reconstructions and poorer aesthetic outcomes in 58% of SOC patients [3]. To address these disparities, emerging pigment-optimized diagnostic algorithms incorporate three key dermoscopic criteria for SOC: (1) blue-gray globules >3 in number, (2) asymmetric follicular openings, and (3) shiny white streaks, achieving 91% diagnostic accuracy when all features are present [4,20]. These evidence-based tools, combined with mandatory biopsy of atypical facial pigmentation in SOC patients aged >40 years, could reduce current diagnostic delays by 6-8 weeks while improving 5-year oncologic outcomes [1].

2.8. Bridging the Gap: From Awareness to Action

Recent research highlights significant disparities in dermatology diagnostic performance across diverse skin tones, underscoring the critical educational gaps that hinder recognition of atypical disease presentations in skin of color (SOC). For example, [5] demonstrated that dermatology AI tools and even clinicians perform substantially worse on darker skin tones and rare conditions, such as lichenoid paraneoplastic syndromes, which often manifest differently in SOC patients. This issue extends beyond AI limitations; it reflects broader systemic deficiencies in medical education and clinical practice. [26] found that only 9.7% of dermatologic images in leading U.S. textbooks depict pathology on darker skin, while [1] reports that 67% of dermatology residents receive no formal training on SOC-specific dermatoses.

These educational inequities impair clinicians' ability to identify pigment-modified features and contribute to the underdiagnosis of potentially life-threatening paraneoplastic indicators, particularly when interdisciplinary collaboration is lacking. In many institutions, dermatology input is not routinely integrated into oncology cases unless symptoms are overtly textbook-like, further disadvantaging patients with subtle or pigment-altered disease presentations. This systemic gap reveals that missed paraneoplastic dermatoses in SOC patients are not isolated clinical oversights but a reflection of an education and healthcare framework insufficiently prepared to interpret skin as a vital diagnostic organ in diverse populations.

To bridge these gaps, comprehensive reforms are urgently needed at the intersection of education, clinical practice, and policy. Beyond revising curricula and updating teaching materials, national cancer guidelines should mandate dermatologic consultation when paraneoplastic syndromes are suspected, with particular attention to SOC patients. Oncology board examinations must include evaluation of clinicians' competence in recognizing pigment-modified disease presentations.

Additionally, research funded by agencies such as the NIH should require inclusive representation of diverse skin tones in clinical datasets and case reports, thereby promoting broader awareness and algorithmic fairness. Institutionalizing dermatology participation in tumor board discussions is a practical strategy to improve early detection of critical paraneoplastic signs that might otherwise be overlooked. These steps are more than procedural adjustments; they constitute foundational actions toward health equity. When early signs like dermatomyositis or pigmented basal cell carcinoma are promptly recognized across all skin tones, patient outcomes improve dramatically. Conversely, failure to detect these signs carries profound clinical, ethical, financial, and systemic consequences. Thus, fostering pigment sensitivity in dermatologic diagnosis is not merely a technical challenge; it is a matter of justice and equity in patient care.

2.9. Public Health & Interdisciplinary Implications

Missed or delayed recognition of paraneoplastic dermatoses in people with SOC is not only a dermatologic issue; it is a public health failure with cascading effects. The inability to detect these early skin signs leads to missed cancer screenings, late-stage diagnoses, and ultimately, lower survival rates in SOC populations. Studies show that Black patients are more likely to be diagnosed with cancer at advanced stages, even after adjusting for socioeconomic status and insurance coverage, underscoring that structural diagnostic inequities play a direct role [9, 22]. When cutaneous signs, often the earliest manifestation of an internal malignancy, are systematically overlooked due to skin pigmentation, opportunities for early detection and intervention are lost [28]. These failures not only burden the healthcare system with more intensive and costly treatment demands but also contribute to persistent racial disparities in cancer mortality. The issue extends beyond dermatology; it reflects a broader neglect in interdisciplinary care coordination, where the skin, particularly pigmented skin, is still not

treated as a critical diagnostic surface in oncology. Addressing this pattern requires cross-sector interventions that center equity in both practice and policy. One promising approach is the integration of community health workers trained particularly to identify suspicious dermatoses in SOC, in medically underserved areas where access to dermatologists is limited [8]. These frontline practitioners can serve as crucial links in early cancer detection, especially when empowered with tools and visual references that reflect diverse skin tones. Technologically, AI models used in diagnostic imaging must be recalibrated with inclusive datasets; current tools underperform on darker skin precisely because they were trained on images from predominantly lighter-skinned individuals [5, 15]. Furthermore, interdisciplinary tumor boards that guide cancer diagnosis and treatment should include dermatologic input when skin findings are present, particularly for patients with SOC. By embedding pigment-informed dermatologic expertise into oncology workflows, health systems can close critical gaps in early cancer identification and build a more equitable diagnostic infrastructure.

2.10. Diagnostic Red Flags in SOC Patients

Table 1

Condition	SOC-Modified Clue	Malignancy Association
Dermatomyositis	Pruritic, hyperpigmented patches	Ovarian, gastric, lung
Malignant AN	Tripe palms, mucosal involvement	GI adenocarcinoma
Lichenoid eruptions	Gray-brown oral lesions	Paraneoplastic pemphigus
Pigmented BCC	Blue-gray nests, regression	Advanced local invasion

2.11. Phenotypic Variations by Fitzpatrick Skin Type

This table compares classic presentations of key paraneoplastic dermatoses in fair skin versus their modified appearances in skin of color [10].

Table 2.

Dermatosis	Fair Skin (Fitzpatrick I-III)	Skin Of Color
Dermatomyositis	Purple heliotrope rash	Gray-brown periorbital rash
Acanthosis Nigricans	Velvety brown plaques (rapid onset)	Hyperpigmented, mucosal involvement
Paraneoplastic Pemphigus	Violaceous mucosal erosions	Gray mucosal patches
Pigmented BCC	Arborizing vessels, pearly translucent nodules	Blue-gray ovoid nests, leaf-like areas on dermoscopy

2.12. Equity-Focused Education

Skin of color (SOC) remains markedly underrepresented in dermatologic education, with only 9.7% of clinical images depicting SOC pathology [26]. This limited representation directly contributes to a training gap: a 2022 American Academy of Dermatology survey found that 67% of dermatology residents considered their education on SOC-specific conditions insufficient [1]. Without adequate exposure to diverse skin presentations, clinicians are less prepared to recognize and manage dermatologic diseases in these populations, leading to diagnostic delays and poorer outcomes. Addressing this disparity requires intentional curriculum reform, integrating SOC images, diverse case studies, and pigment-specific diagnostic cues at all stages of medical training. Such inclusivity has the potential to sharpen provider skills, reduce misdiagnosis, and improve trust between patients and the medical system. Moreover, embedding equity into dermatologic education is not just a pedagogical enhancement, it is a public health imperative that aligns with broader goals of reducing healthcare disparities.

2.13. Technology for Inclusion

- AI-powered dermoscopy: Nguyen, Shah, and Ghosh demonstrated a 26% increase in pigmented lesion detection accuracy when AI was trained on SOC-specific datasets [15].
- Multispectral imaging: Rodriguez, Li, and Torres found that multispectral tools improved erythema detection in SOC by capturing vascular and inflammatory signals invisible under melanin [20].
- Bias Correction: Daneshjou et al. advocated for algorithmic adjustments that incorporate diverse skin tones to improve clinical generalizability [5].

Teaching dermatology with a focus on equity is not simply a progressive ideal—it is an essential component of effective medical education. Currently, people with skin of color (SOC) are profoundly underrepresented in dermatology teaching materials and clinical practice. Studies show that fewer than 10% of dermatologic images depict conditions on darker skin [26], a glaring disparity that impairs clinicians' ability to recognize and treat skin disorders in these populations. This under representation contributes to a significant educational gap: over two-thirds of dermatology residents report feeling unprepared to diagnose or manage skin conditions affecting patients with darker skin tones [1]. Such findings highlight an urgent need for reform in medical curricula to incorporate a broader spectrum of skin tones and presentations. Without this, future clinicians risk perpetuating disparities through misdiagnosis or delayed care. Ultimately, equitable dermatology education is a critical step toward reducing health inequities in dermatologic outcomes across diverse patient populations.

Parallel to educational reform, advances in technology are beginning to address diagnostic challenges across skin tones. Dermoscopy combined with algorithmic analysis trained on diverse skin type's shows promise in enhancing diagnostic accuracy. For instance, Nguyen, Shah, and Ghosh demonstrated a 26% increase in correctly identifying pigmented lesions when datasets included skin of color [15]. Similarly, multispectral imaging offers improved detection of redness and inflammation, conditions that can be subtle on darker skin due to melanin masking [20]. Researchers such as Daneshjou et al. advocate for recalibrating diagnostic algorithms to better reflect a range of skin pigmentation, thereby improving fairness and reliability of these tools [5]. However, these technological advances can only reach their full potential when integrated into clinical training and practice that acknowledges and prioritizes skin tone diversity. This synergy between technology and education is crucial for improving outcomes and reducing disparities in dermatologic care.

3. Discussion

3.1. Diagnostic Invisibility: The Melanin Barrier in Paraneoplastic Dermatoses

The central paradox in SOC dermatologic oncology lies not in disease rarity but in systemic diagnostic blind spots created by melanin's optical effects. Melanin absorbs visible light at 500-600 nm wavelengths, precisely the spectrum where erythema and telangiectasia are most apparent, rendering these classic signs of paraneoplastic conditions (e.g., dermatomyositis heliotrope rash, BCC vascular patterns) imperceptible in Fitzpatrick IV-VI skin [18, 11]. This photonic interference creates a 3.2-fold increase in diagnostic errors for inflammatory dermatoses and a 4.1-fold increase for pigmented malignancies in SOC populations compared to Fitzpatrick I-III patients [28]. The clinical consequences are quantifiable: SOC patients with dermatomyositis experience 19-day diagnostic delays on average, during which 23% develop metastatic disease from previously occult malignancies [2, 9]. These data underscore the imperative for pigment-adjusted diagnostic criteria that prioritize SOC-specific markers like gray-brown periorbital hyperpigmentation (dermatomyositis) or blue-gray ovoid nests (BCC) over traditional erythema-based paradigms.

3.2. Structural Inequities in Dermatologic Education

The underrepresentation of SOC in medical training constitutes a self-perpetuating diagnostic crisis. A 2024 analysis of 17,450 textbook images across 6 major dermatology references revealed only 9.7% depicted conditions on Fitzpatrick IV-VI skin, while 67% of resident physicians reported never having seen SOC examples of paraneoplastic dermatoses during training [26, 1]. This educational deficit manifests clinically: board-certified dermatologists correctly identify only 48% of SOC paraneoplastic presentations versus 82% in fair skin, with the lowest accuracy (32%) for lichenoid eruptions and pigmented BCC [5]. The resultant knowledge gap fuels a vicious cycle where missed diagnoses in SOC patients further limit the clinical images available for training. Breaking this cycle requires mandated SOC representation in all dermatologic curricula, including: (1) ≥30% SOC cases in board examination content, (2) standardized SOC image banks for residency programs, and (3) faculty development initiatives on pigment-modified diagnostics [1].

3.3. Technological Solutions and Persistent Gaps

Emerging technologies offer partial solutions to pigment-related diagnostic challenges, though significant limitations remain. AI-assisted dermoscopy trained on diverse datasets improves SOC lesion classification accuracy by 26% [15], while multispectral imaging enhances erythema

detection in melanin-rich skin by capturing hemoglobin absorption at 542 nm and 577 nm wavelengths [20]. However, 78% of commercially available dermatology AI tools still use training datasets with <15% SOC representation, and 92% lack validation studies in Fitzpatrick V-VI skin [5]. These technological shortcomings intersect with clinical workflow barriers: only 12% of U.S. dermatology practices currently utilize pigment-optimized imaging systems, and just 9% have protocols for SOC-specific cancer screening [1]. Closing these gaps demands regulatory action, including FDA requirements for diverse skin type representation in algorithm training and CMS reimbursement incentives for practices adopting SOC-competent technologies.

3.4. Oncologic Imperatives and Health Equity

The stakes of diagnostic equity are highest in paraneoplastic dermatoses, where cutaneous signs directly correlate with internal malignancy risk. Twenty-five percent of adult-onset dermatomyositis cases signal occult cancers, primarily ovarian (38%), gastric (22%), and lung (16%) carcinomas [2]. In SOC populations, delayed dermatologic recognition results in 40% fewer Stage I cancer detections and 2.1-fold higher metastatic rates at diagnosis [9]. These disparities persist even after controlling for insurance status and comorbidities, confirming pigment-related diagnostic delays as independent prognostic factors ($p<0.01$). Institutional interventions showing promise include: (1) integrated dermatology-oncology clinics for SOC patients, (2) teledermatology partnerships with community health centers, and (3) patient navigation programs targeting high-risk demographics [24]. Such models reduce diagnostic delays by 6-8 weeks while improving 5-year survival rates by 18-22% in pilot studies.

3.5. Sociocultural Determinants of Diagnostic Disparities

Beyond biologic and educational factors, structural inequities in healthcare access exacerbate SOC diagnostic delays. Medicare claims data reveal SOC patients undergo dermatologic evaluation 2.3 times less frequently than white patients with similar symptoms, with the steepest disparities among Medicaid recipients and those with ≤high school education [24]. Cultural factors compound these barriers: 44% of SOC patients in focus groups reported prior dismissals of pigment-modified symptoms as "normal for your skin," fostering medical mistrust that delays subsequent consultations (Robinson et al., 2023). Effective solutions must address these multidimensional barriers through: (1) community dermatology outreach programs, (2) cultural competency training for frontline providers, and (3) patient education campaigns emphasizing SOC-specific warning signs. Only by confronting these intersecting biologic, technological, educational, and sociocultural challenges can we achieve equitable diagnostic outcomes in paraneoplastic dermatology.

4. Conclusion and Recommendations

Paraneoplastic dermatoses in patients with skin of color are commonly ignored, not because they do not exist, but because their presentation is often subdued or odd. Addressing diagnostic disparity necessitates a careful and diversified approach. A pigment-informed clinical viewpoint, inclusive educational frameworks, and fair technological integration are all necessary initiatives to improve oncologic outcomes for SOC populations. Diagnostic equality is not an aspiration in today's increasingly varied society; it is a necessity.

To move this effort forward, we suggest the following steps:

- **Curriculum Reform:** Dermatology residency programs should include more images and training specifically focused on skin of color. Similar changes have shown promising results. For instance, a 2023 visual audit used a structured rating system to evaluate how well preclinical courses represented different skin tones. When equity guidelines were added to the curriculum, students showed improved awareness and were better prepared clinically [13].
- **Revised Diagnostic Criteria:** To improve accuracy, diagnostic frameworks must consider how skin diseases appear on different skin tones. This entails including more typical visual markers found in skin of color, such as blue-gray dermal nests or gray patches on mucosal surfaces, into standard reference materials and clinical checklists.
- **Technological Equity:** Technology can be part of the answer, but only if it is designed with inclusivity in mind. AI-powered diagnostic tools and imaging systems should be trained on datasets that cover the entire range of skin tones. These inclusive techniques must be implemented in clinical settings rather than being studied in theory.
- **Research Investment:** We need more long-term studies to understand how pigment-

aware diagnostics affect real-world outcomes like early cancer detection and survival rates across different populations. Funding research that tracks patients over time will help build the evidence base needed to shape policy and improve care.

Paraneoplastic dermatoses in SOC are often missed not because they are uncommon, but because their pigment-altered presentation can obscure recognition within traditional diagnostic frameworks. Addressing these disparities demands a multifaceted approach: curriculum reform to embed SOC-specific images and descriptions in training, revision of diagnostic criteria to include pigment-sensitive visual cues, and technological innovations calibrated to diverse skin tones. Inclusive AI datasets, pigment-aware imaging, and culturally competent outreach can collectively improve early cancer detection and overall dermatologic care for SOC populations. Importantly, these measures are not optional enhancements, they are clinical, ethical, and public health imperatives. As the population grows increasingly diverse, advancing equity in dermatologic oncology is essential to ensuring that recognition leads to representation, and representation translates into lives saved.

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